EAST BASS BASIN
part 7.

023001

FINAL REPORT

GIPPSLAND, BASS STRAIT-ANGLESEA,

and SOUTH AUSTRALIA AREAS

MARINE SEISMIC SURVEY

For

HAEMATITE EXPLORATIONS PTY., LTD.

By

WESTERN GEOPHYSICAL COMPANY OF AMERICA

Party 86

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OR - 044

Western

CONTENTS

SUMMARY

A reconnaissance reflection seismic survey was conducted in three separate offshore areas by Western Geophysical Company of America for Haematite Explorations Pty. Ltd. One area was off the coast of Gippsland, Victoria, one in Bass Strait, north of Tasmania, and the third along the southeastern coast of South Australia. The survey was carried out in two phases. The initial phase, consisting of a broad reconnaissance program with very large loops, was followed by a second phase, based on a preliminary interpretation of data recorded in the first, which provided closer control over the features of interest. The Gippsland and Bass Strait areas yielded reflections of generally fair to good quality, but the South Australia Area proved to be a poor record area. In each area seismic results revealed the existence of an adequate thickness of sedimentary section and several structural features of sufficient size to warrant further investigation.

I. GENERAL INFORMATION

A. Location of Areas

1. Gippsland Area

The area surveyed begins about 8 miles off the Ninety Mile Beach, state of Victoria, and reaches out to a distance of approximately 60 miles. It extends from a point near Port Welshpool to about 30 miles east of Lakes Entrance.

2. Bass Strait - Anglesea Area

This area is located in Bass Strait north of Tasmania, between King Island and Flinders Island. The survey extended some 140 miles in a northwest-southeast direction and 70 miles in a northeast-southwest direction. The main body of the survey was connected by seismic profiles to the Anglesea well on the south Victoria coast.

3. South Australia Area

Beginning at the Victoria-South Australia border, this area extends along the coast of South Australia to a point just south of the Fleuricu Peninsula. Its offshore extent varied from fifteen to forty miles.

B. Purpose of Assignment

The survey was designed to:

1. Verify the presence of an appreciable thickness of sedimentary section as interpreted from magnetic data.
2. Obtain further control to delineate the shape and extent of sedimentary basins.
3. Locate any structural features favorable for the accumulation of petroleum and/or gas.

C. Chronology

October 31, 1962	Boats arrived Australia.

November 19, 1962	Rigging completed, sailed for Gippsland.
January 5, 1963	Gippsland Area completed. (Adjacent area surveyed concurrently for another client.)
January 10, 1963	Sailed for Bass Strait Area.
February 7, 1963	Original Bass Strait assignment completed.
February 12, 1963	Sailed for South Australia Area.
February 27, 1963	Original South Australia assignment completed.
March 5, 1963	Sailed for Anglesea Area.
March 7, 1963	Anglesea Area completed.
March 8, 1963	Commence work for another client.
March 22, 1963	Shooting additional program in South Australia Area.
March 23, 1963	Commence work for another client.
March 28, 1963	Sailed for Gippsland to commence added program.
April 6, 1963	Added program in Gippsland completed.
April 11, 1963	Sailed for Bass Strait to commence shooting added program.
May 11, 1963	Added program in Bass Strait completed.

D. <u>Contractor</u>

The seismic survey was conducted as a turnkey operation by Western Geophysical Company of America, 933 North La Brea Avenue, Los Angeles, California, U. S. A.

Navigation and shot point location were provided by Offshore Navigation, Inc., New Orleans, Louisiana, U. S. A.

E. Operational Problems

Strong winds and heavy seas severely hampered operations in all areas and a scarcity of places affording shelter sometimes resulted in many hours of extra cruising time.

Maximum Shoran range was required to cover certain portions of the Bass Strait Area. Consequently, operations were sometimes curtailed by climatic conditions unfavorable to Shoran signal propagation.

In the South Australia Area, heavy concentrations of crayfish pots and fishing boats often hampered operations and caused the loss of some geophones.

II. RECORDING OPERATIONS

A. Major Boat Equipment

1. Recording Boat - Motor Vessel "Oil Creek", an 86-foot steel hulled vessel equipped with two 6-110 GM marine engines and especially constructed for use as a geophysical recording boat. In addition to the seismograph recording equipment, the vessel is equipped with radar, ship-to-ship and ship-to-shore radios.

2. Shooting Boat - Motor Vessel "Bluff Creek", a sister ship of the "Oil Creek" with a full load capacity of 200,000 pounds of explosives.

B. Surveying

Navigation and shot point positioning at pre-plotted locations were accomplished by use of the SHORAN system. Three base stations were used to allow flexibility in the operating area by allowing movement of one base station while operating from the other two. Both boats were equipped with mobile SHORAN units. Navigation control was provided by the unit aboard the M/V "Oil Creek" and shot point positions were established by the unit aboard the M/V "Bluff Creek".

A complete report on SHORAN operations in the survey is submitted as APPENDIX A.

C. Recording Technique

The normal two-boat suspended charge method was utilized throughout the survey. In this method of operation the shooting boat cruises parallel to the detector cable, which has been towed into position by the recording boat, and drops the charge opposite the center buoy of the cable at a distance of approximately 250 feet. After the shooting boat has moved away, the charge, which is suspended four or five feet below the surface depending on charge size, is detonated electronically.

D. Dual Recording

Through use of a special dual-purpose cable, two simultaneous 24-trace recordings (both monitor records and magnetic tapes) were made at each point. One recording covered the entire length of the detector cable (7778 feet), while the other covered approximately one-half the length of the cable (3838 feet). Both recordings are centered at the shot point. A normal shot point interval of 1968 feet was used, yielding 100% continuous subsurface coverage by the short cable and 200% overlapping subsurface coverage by the longer cable.

E. Detector Cable

A Vector marine floating cable, constructed to Western specifications, was used in this survey. The construction consists of regular conductors wrapped around an insulated steel stress core and encased in a neoprene jacket. This entire conductor-stress member unit is then encased in cellular polyethylene to provide flotation. This cable is effectively two cables and will be referred to in this report as the short and long cables.

The cable contains 36 groups of four geophones each. Each group consists of two pairs of geophones; in each pair the detectors are spaced four feet apart, while the pairs are spaced 61.6 feet apart. Groups 7-30, composing the short cable, are spaced 164 feet (50 meters) apart from center to center. Groups 1 - 6, 7, 9, 11, 13, 15, 17, 20, 22, 24, 26, 28, 30, and 31 - 36 compose the long cable and are spaced 328 feet apart, except at the center of the cable where groups 17 and 20 (12 and 13 of the long cable) are 492 feet apart. The overall length of the cable from the first to the last geophone is 7777.6 feet. See Plate III for a diagram of this cable.

F. Reversing Plugs

In order to hold cruising time to a minimum by allowing freedom to shoot any line in either direction and yet obtain records tying together in a pre-determined direction, it was necessary to use reversing plugs on certain lines. A recorded check on the orientation of the cable is provided by the position of the time break; it appears on trace 2 of the monitor records when the reversing plugs were not in use and on trace 23 when they were used.

G. Spread Lengths

A constant shot point interval of 1968 feet was used in pre-plotting the shot point locations. Actual spread lengths were computed from direct through-water time arrivals recorded on the lower part of the short cable monitor records through special water break amplifiers. The eight water arrival traces represent cable groups 1, 4, 7, 13, 24, 30, 33, and 36. Travel time from the shot to each end of the long cable is recorded on traces 1 and 8 of the water break traces, while traces 3 and 6 show times to the ends of the short cable.

H. Explosive Charges

The charge size varied from 25 to 50 pounds, resulting in an average per shot point of 47 pounds for the Gippsland and South Australia Areas and 36 pounds for the Bass Strait-Anglesea Area.

I. Instrumentation

1. Magnetic Tapes

At each shot point, energy from the long and short cables was recorded simultaneously on two magnetic tapes by Western-Techno tape recorders. Western FA-32 amplifiers equipped with variable gain control and plug-in type filters were used. Tapes were recorded in broad-band filters, FL and 18-63, Tape AVC, and with no mixing. Plate IV of the exhibits shows the amplitude response of the filters used.

2. Conventional Field Records

Energy from each cable was also recorded on paper at each shot point. Instrumentation was the same as on the magnetic tapes in order that the energy being recorded on the tapes might be monitored.

3. Field Playback Records

From each short cable tape a variable area playback was made on 3-inch film to provide data for a preliminary interpretation being made concurrently for programming purposes. Various filters were tried, but the CFv appeared to give the best results and was used throughout the area. Frequent paper playbacks were made with different filters to make certain that the most suitable filter was being used.

III. DATA PRESENTATION

A. Preliminary Interpretation

In the Melbourne office the uncorrected film playbacks made during recording operations were spliced together, with the time break used as the zero reference line. From the 12-record sections thus constructed, ozalid prints were made and from these a time map at the basal Tertiary level was made. These sections could be assembled quickly and proved quite satisfactory for the intended purpose.

B. Detailed Interpretation

Fully corrected Western Dual Display record sections (variable density superimposed over normal "squiggle" recording) were made from playbacks of each short spread tape and alternating long spread tapes. These playbacks were dynamically corrected for normal moveout by use of the Western 22C moveout cam for the short spreads and the MP cam for the long spreads. The CFv filter and standard AVC were employed. There was no mixing of the energy from adjacent groups.

The long spread sections were used in conjunction with the short spread sections to distinguish the primary reflections from multiple events. The latter could be recognized on the long spread sections by the noticeable curvature remaining after the correction for normal moveout had been made.

The original sections were made with a vertical scale of 10 inches per second and a horizontal scale of approximately 1 inch equal to 615 feet. Then all sections were photographically reduced to two-thirds their normal size. In addition, all short spread sections were reduced to one-fourth the original size. The latter proved to be an invaluable aid to the interpretation by providing a condensed seismic profile of a large area in which regional trends, faulting, unconformities, and other significant features were more apparent.

IV. COMPUTING

A. Specific Methods

When in shooting position, the detectors were suspended 14 feet below the surface and the charge was detonated 5 feet below the surface. Therefore, each field record was corrected to a sea level reference plane by raising the shot and detectors to the surface at water velocity and by applying the appropriate filter lag correction. Thus, a tape played back in the CFv filter for record sectioning was corrected as follows:

Correction to plane	+.004
FL (tape) filter lag	-.012
CFv filter lag	-.019
Total correction	-.027 seconds

B. Velocities

A water velocity of 5000 feet per second was used for correcting the charge and geophones to sea level.

Velocity information from a survey of the Wellington Park No. 1 well was available for the Gippsland Area, but there was some doubt as to its validity for the entire area. Consequently, average velocities were computed from normal moveout-velocity analyses of lines G-2, G-3, and G-4. These were limited by the lack of adequate reliable data below the Tertiary section. Plates V and VI show time versus depth and depth versus velocity curves from the Wellington Park No. 1 well, in addition to plotted values of the computed velocities.

No velocity information was available on the Bass Strait-Anglesea Area. Normal moveout-velocity analyses were made of lines B-9, B-10, and B-11. Plates VII and VIII show average time-depth and depth-velocity curves derived from these analyses.

Velocity information was also lacking in the South Australia Area and, due to the extensive faulting encountered and the generally poor reflection quality, there was insufficient data for a velocity analysis in the area. From the observed moveouts it was evident that substantial velocity changes occurred across the area.

V. MAPS

A. Base Maps

Shot point location maps were prepared by Western on Cronaflex film from post-plotted positions furnished by Offshore Navigation, Inc. These base maps were constructed on a transverse Mercator projection (Australia) on a 1 degree by 1 degree grid to a scale of 1:100,000.

All contoured maps were prepared on sepia prints of these shot point base maps. Then, by photographic reduction, all maps were reproduced on film to scales of 1:250,000 and 1:126,720 (1 inch equals 2 miles). Using the 1:250,000 scale, composite maps were constructed for each area.

B. Contoured Maps

Concurrently with the recording operations, a time map was made from the basal Tertiary reflection in the Gippsland and Bass Strait-Anglesea Areas. A map was also made in the South Australia Area, but it was essentially a discontinuous dip map which did not represent a particular horizon. These preliminary interpretations were used in programming additional lines in areas of interest.

In the more detailed interpretation made in the U. S. A. after the completion of recording operations, structure maps in two-way time were prepared as follows:

1. Gippsland Area:

   (1) Miocene Phantom Horizon
   (2) Basal Tertiary Reflection Horizon
   (3) Pre-Tertiary Dips (not contoured)

2. Bass Strait-Anglesea Area:

   (1) Shallow Reflection Horizon
   (2) Basal Tertiary Reflection Horizon
   (3) Pre-Tertiary Dip Segments (Map 1 only)

3. South Australia Area:

   (1) Oligocene Phantom Horizon
   (2) Basal Tertiary Reflection Horizon

An iso-time map of the interval between the two horizons was made in each of the first two areas. None was submitted for the South Australia Area. Due to the loose control of the survey and the extensive faulting at the deeper level in this area, it was believed that the contouring of the available isochronous data would be overly speculative.

A water depth map, based on continuous fathometer recordings, was prepared for each area.

VI. INTERPRETATION

A. Gippsland Area

1. Data Quality

No shallow reflection was recorded which could be mapped continuously over the entire area. However, there were usually several shallow events of satisfactory quality, at least one of which could be traced over a considerable distance. Thus, a reliable phantom horizon could be made. The data deteriorated locally in some places, particularly in the extreme southeast corner of the area where the deeper water generated bottom multiples which tended to obscure the shallow reflections.

The zone between the shallow and the basal Tertiary horizon was characterized by discontinuous reflections, often showing erratic dips conforming to neither the shallow nor the deeper events.

The reflection tentatively identified as basal Tertiary is generally of fair to good quality and maintains continuity over most of the area. Although it does not exhibit a definite character throughout, correlations across faults are believed to be accurate to within one cycle in most cases.

In limited areas valid reflections were recognized below the deeper horizon and shown as dip segments on the pre-Tertiary dip map. The scarcity of deep data is probably due to the shielding effect of the Latrobe Valley Coal Measures which resulted in relatively little energy from the deeper formations reaching the surface. These weaker events were apparently obscured by multiple reflections.

The strong reflectors present at relatively shallow depths produced many multiple reflections. Although they interfered with the deeper reflections to such an extent that a continuous map could not be made below the Tertiary, these multiples presented no real problem at the two horizons mapped since they were usually indentifiable on the long spread sections.

At the northeastern and extreme western ends of the area, it was necessary to discontinue the mapping horizons due to the very shallow basement encountered in those sectors. There the Tertiaries lie directly on basement, as verified by plots of the refracted first arrival times which show velocities of 6500 feet per second immediately followed by velocities of 18,000 feet per second.

2. Origin and Extent of Structural Horizons

   a. Miocene Phantom Horizon

   Since no continuous shallow reflection was recorded, a zone was selected for this phantom horizon which would not be too near the deeper horizon and which would allow most of the surveyed area to be mapped without outcropping on the flanks of the basin. Available information from coastal wells indicates that the level chosen is approximately Miocene in age. The horizon goes from a possible outcrop in the shallow basement zones to a maximum depth of about 5000 feet.

   b. Basal Tertiary Reflection Horizon

   This horizon was based on a relatively strong reflection which was recorded over the entire area, except in the zones of shallow basement and a small portion in the southeastern part of Map 2, where the reflection deteriorated and it was necessary to project the horizon by phantoming from slightly deeper events. This reflection is believed to represent the basal Tertiary zone consisting of the Latrobe Valley Coal Measures which have a considerable range of velocities and consequently could be expected to give strong reflections. Because of the changing character of the reflection and the extent of the survey, the horizon as mapped probably does not represent the same lithologic unit over the entire surveyed area. The depth of the horizon varies from less than 1,000 feet to approximately 10,000 feet.

c. Pre-Tertiary Dip Map

Deep reflections considered to be reliable were shown as dip segments on this map. Because of the interference of many multiples generated by the younger beds, these pre-Tertiary reflections were obscured over most of the area.

3. Structural Features

a. General Considerations

The area surveyed consists primarily of two major anticlinal trends. Features "A" through "H" lie on one ridge which trends roughly ENE-WSW from feature "A" through "C", then swings to the east through feature "F", and finally curves to a southeastward trend through feature "H". The second anticlinal ridge, lying roughly north of and parallel to the first, consists of individual closures lettered "I" through "M". This ridge extends in a general east-west direction from feature "I" through "K", then curves southeastward through feature "M".

The first-mentioned high trend lies roughly in the center of the Gippsland sedimentary basin. The second tends to parallel the Rosedale fault, which enters the surveyed area near the intersection of lines G-1 and G-9. North of this fault, monoclinal south dip was noted to extend from the basement high at Lakes Entrance to the downthrown side to the fault.

The unconformity known to exist between the Mesozoic and Tertiary strata is evidenced in several places despite a general scarcity of pre-Tertiary reflections and the interference of multiple events.

Another unconformity was observed above the basal Tertiary reflection. It is very prominent on several lines, but is most noticeable on line G-3. This unconformity seems to occur at the base of a rather thick zone of irregular, and often incoherent, dip segments conforming to neither the shallow nor the deeper reflections. The geological significance of these conflicting dips has not been fully determined, although there is recurring evidence of one or more periods of large scale erosion. Other evidence suggests the possibility of regional tilting during the Tertiary, as well as slumping of the younger Tertiary beds after deposition. Closer control and further study, supported by pertinent geological information of the area, would be needed to answer all the questions posed by this anomalous zone.

The southwestern portion of the survey area is undisturbed shelf area with a suggestion of a WNW trending hinge line, north of which the rate of dip increases somewhat and structural features begin to develop.

b. Anomalous Features

(1). Feature "A"

This feature is located on maps 3 and 5 east of the intersection of lines MA-2 and G-6. At the deep horizon the closure is contoured to show an areal extent of approximately 6 by 9 1/2 miles, with vertical relief of about 200 feet. Gentle arching on line G-6 and the flattening of dip on line MA-2 are based on good data. However, because of lack of control in the immediate vicinity of the closure, the contouring here must be considered speculative. This anomaly appears at the shallow level as an ENE plunging nose which is shifted to the north of the deep closure.

(2). Feature "B"

Like feature "A", this one is formed at the deep horizon by speculative contouring, with no control in the immediate vicinity of the closure. This possible closure is situated on map 3, east of the intersection of lines MA-1 and G-7. Contoured with horizontal closure of 4 1/2 by 6 miles, it shows structural relief of possibly 215 feet. The small arch on line G-7 and the anomalous flattening on line MA-1 are supported by excellent reflections on both lines. The shallow horizon is contoured as a broad, gently plunging nose, which is shifted slightly to the north of the deep closure.

(3). Feature "C"

This anomaly is centered between lines G-13 and G-17 near line G-14 and appears on map 3. The deep closure is elongated east-west, with an areal extent of 4 by 10 1/2 miles and contoured structural relief of approximately 425 feet, independent of faulting. Closure is based on data of good quality which shows arching on lines G-13, G-17, and G-14, with the latter line showing 94 milliseconds of good southwest dip from the crest at shot point 77 to the southwest end of the line, and 60 milliseconds of good northeast dip to the down-to-the-east fault cutting the line between shot points 65 and 66. The feature is expressed at the shallow horizon as part of the same gentle, broad nose that crosses feature "B". Structural growth during deposition is evidenced by ample thinning over the feature. Water depth over the crest is approximately 125 feet.

(4). Feature "D"

Located on map 3 near the intersection of lines G-2 and G-8, this anticlinal structure is present at the deep horizon only. The closure measures 4 by 4 1/2 miles, with approximately 225 feet of vertical closure. The controlling arches on lines G-2 and G-8 are based on excellent data. Some isochronous thinning is noted on this structure which lies under 160 feet of water.

(5). Feature "E"

This anticlinal structure, lying east of feature "D" in map 3, is present at both horizons. The anomaly at the deep horizon has an areal extent of 3 by 5 1/2 miles and a minimum structural relief of 240 feet. Controlling data on lines G-15 and G-18 are provided by an excellent reflection. The feature appears at the shallow horizon with a closure of 3 1/2 by 4 1/2 miles and at least 100 feet of relief. Data quality at this level is fair to poor. There is ample thinning over the structure lying in 190 feet of water.

(6). Feature "F"

This feature is located on map 3 east of feature "E". At the deep horizon it is mapped as a faulted anticline of 6 by 6 1/2 miles in areal extent and with about 475 feet of contoured structural relief. The arch on line G-9 is based on a good reflection which is interrupted by two down-to-the-east faults of poor quality. However, these small faults do not appear to affect the dimensions of the structure. A closure of 5 1/2 by 7 1/2 miles, with perhaps 100 feet of vertical relief, was mapped at the shallow horizon. Structural growth of the feature is supported by noticeable thinning at the crest on line G-9. The water depth at this point is about 190 feet.

(7). Feature "G"

Feature "G" is centered at the junction of maps 2 and 3 between features "F" and "H" and is present at the deep horizon only. The closure as mapped shows an areal extent of 5 1/2 by 6 1/2 miles and approximately 240 feet of contoured structural relief. However, because of lack of control at the crest, the actual amount of relief is unknown. The closure is formed by arching on lines G-3, G-9 and G-19. Data quality on line G-3 is excellent, while the data on line G-19 is of fair quality and that on line G-9 is fair to poor. Ample thinning on the north flank supports the presence of the deep anomaly. A water depth of 215 feet was recorded over this feature.

(8). Features "H" and "H'"

Feature "H", centered east of feature "G" on map 2, is a large anticlinal structure which is present at the deep horizon only. The anomaly is elongated east-west with closing dimensions of 6 by 12 1/2 miles and minimum structural relief of approximately 850 feet. This closure is based on strong arching on lines G-10 and G-16, supported by data that ranges from fair to poor in quality on both lines. Isochronous thinning of about 150 milliseconds is shown over this feature. The water depth over the crest is 240 feet.

This deep structure is separated from a shallow anomaly, designated feature "H'", by a probable low angle thrust fault that appears to cut the shallow horizon then dies out in the bedding plane above the basal Tertiary horizon. The shallow closure is contoured on the up side of this probable fault, which apparently thrusts from the northeast. At the shallow level the fault crosses line G-16 between shot points 68 and 69, and line G-10 between shot points 112 and 113. A closing area of 3 by 7 miles is contoured with vertical relief of approximately 160 feet.

(9). Feature "I"

Feature "I", located on map 3 near the intersection of lines G-9 and G-14, appears as a faulted anticlinal structure on the deep map only. This elongated feature, with an ENE-WSW axis, is cut by a poorly evidenced down-to-the-south fault which passes between shot points 37 and 38 of line G-14. The closure as contoured shows an areal extent of 3 by 11 miles and structural relief of about 530 feet. It is formed by strong arching on lines G-14, G-9, and G-18. Controlling data on lines G-14 and G-18 are provided by a reflection of good quality. The data on both flanks of the arch on line G-9 are good, but deteriorate near the crest where a possible fault is noted. This anomaly is expressed at the shallow horizon as a high nose. Considerable isochronous thinning was mapped over the structure which lies in 140 feet of water.

(10). Feature "J"

Situated on map 3 east of feature "I", this is an anticlinal structure that is contoured to show 3 by 7 miles of closure and about 215 feet of vertical relief. Due to the lack of east-west control at the crest, the amount of relief is questionable. If closing west dip is not present as contoured, this closure becomes an elongation of feature "I", increasing the total axial length of that closure to about 20 miles. A small down-to-the-north fault cuts the north flank of the structure, but does not appreciably affect the amount of closure. The arching on line G-19 is supported by excellent data while that on lines G-2 and G-10 is based on data of fair to good quality. Nosing is present at the shallow horizon. Isochronous thinning similar to that over the previous feature was mapped. Approximately 160 feet of water was recorded over the crest.

(11). Feature "K"

Feature "K" is located east of feature "J" at the junction of maps 2 and 3. At the deep horizon the closure is contoured to show an areal extent of 4 by 8 miles, with approximately 450 feet of vertical relief. However, due to the presence of faulting on both the north and south flanks of the structure, the area and relief of the closure are open to question. The dip reversal on line G-20 is based on a very good reflection which is interrupted by a good down-to-the-north fault at shot point 6, and a fair down-to-the-south fault between shot points 16 and 17. The size of the closure could be altered by a possible change of one cycle in the correlation within this horst block. At the shallow horizon the closure is about 6 by 16 miles in areal extent, with a structural relief of 375 feet. Some local isochronous thinning is evident. The water depth over the crest is 175 feet.

(12). Feature "L"

This feature appears on map 2 southeast of feature "K". A prominent nosing to the southwest, based on 75 milliseconds of northwest dip on line G-20, gives this closure an irregular shape. At the deep horizon the feature has closing dimensions of roughly 9 by 11 miles, with approximately 675 feet of controlled structural relief. The closure is based on data of generally fair quality, except at the crest where the data are very poor to questionable. At the shallow horizon a closing area of 6 by 10 miles is contoured with a structural relief of 200 feet. Approximately 525 feet of isochronous thinning is shown. The water depth is 190 feet.

(13). Feature "M"

This lead is located on map 2 south of the intersection of lines G-12 and G-16. It is based on dip reversals on lines G-16 and G-12 supported by data of fair quality on both lines. Arching on line G-11 near shot point 94 tends to increase the potential size of the possible closure. The shallow horizon shows a high nose plunging to the southeast. More control to the south and east is needed to properly delineate this feature. The water depth in this vicinity is in excess of 300 feet.

(14). Feature "N"

Feature "N", lying northeast of feature "L" on map 2, is a possible closure bounded on three sides by faulting. Two of these faults, both considered to be reliable, cut line G-3. The southwest flank of the arch on this line is based on very poor to questionable dips while the northeast flank shows fair data. The dips on line G-21 are considered fair in quality, and the fault crossing between shot points 29 and 30 is reliable. Because of the presence of faulting on three flanks, the amount of closure on this possible feature is questionable. No expression of the feature is seen at the shallow horizon. The water depth is about 190 feet.

(15). Feature "O"

This relatively small closure, located on map 2 immediately east of feature "N", measures 3 by 3 1/4 miles with maximum structural relief of 225 feet at the deep horizon. The closure is separated from feature "N" by a fair down-to-the-southwest fault that cuts line G-3 between shot points 68 and 69.

Another fault, believed to be the Rosedale fault, cuts the north flank of the feature near the intersection of lines G-3 and G-12. This fault is downthrown to the north and is considered good on both lines. The closure at the shallow horizon represents a minimum of 75 feet of structural relief. At this level the arch on line G-3 is supported by fair data on the southwest flank, while the northeast flank is questionable. The data on line G-12 are fair to poor. Some isochronous thinning is shown over this structure. The water depth is approximately 190 feet.

(16). Feature "P"

This feature is located on map 2 near the intersection of lines G-3 and G-22. It consists of closure against the upthrown side of a good fault which is downthrown to the northwest. The arching on line G-22 is supported by good data while controlling data on line G-3 range from poor to very poor in quality. Approximately 225 feet of vertical closure against the fault is shown. Because of a lack of data, the shallow horizon was not mapped in this area. The water depth is about 160 feet.

(17). Features "Q" and "R"

These two features, centered south of the intersection of lines G-10 and G-15 at the junction of maps 2 and 3, are evident at the deep horizon only. The two closures, lying on a cross trend between the two main anticlinal ridges that cross the surveyed area, are separated by a fault, downthrown to the south, that cuts line G-10 between shot points 66 and 67. Feature "Q" is formed by good arching on lines G-10 and G-15. The closing area of approximately 3 1/2 by 5 miles shows a possible structural relief of 475 feet. Feature "R" is suggested by good arching on lines G-3, G-10, and G-19. The closure measures some 4 by 8 miles with contoured vertical relief of 240 feet. Ample isochronous thinning is present over the combined features. The water depth is 195-200 feet.

All figures used to indicate structural relief in the preceding discussions are based on a time-depth conversion using the average velocities derived from the normal moveout analyses.

4. Conclusions and Recommendations

The area appears attractive for further exploratory effort.

This broad reconnaissance survey indicated a sedimentary section of Tertiaries and pre-Tertiaries of substantial thickness. Several structures of considerable areal extent and vertical closure were mapped. The technical difficulties presented by the water depths involved would be partially offset by the convenient location of the area near a large and ready market.

More detailed shooting would be necessary to properly evaluate this area and to more accurately delineate the interesting features for drilling purposes. In any future seismic program, at least 300% subsurface coverage with subsequent stacking of data is recommended to improve the quantity and quality of pre-Tertiary data.

B. Bass Strait-Anglesea Area

1. Data Quality

Over most of the area reflections of fair to good quality were recorded down to what was considered to be the base of the Tertiaries.

The reflection mapped as the shallow horizon was relatively strong and maintained good continuity, although it was not correlatable over the entire area.

The basal Tertiary reflection was generally continuous and of fair to good quality, although it deteriorated somewhat in local areas. Correlations across faults are considered to be reliable in most cases.

Many multiple reflections were recorded. These apparently obscured the deeper reflections, because valid pre-Tertiary reflections could be detected only in very limited areas.

2. Origin and Extent of Structural Horizons

a. Shallow Horizon

Since no known marker reflection could be identified in the shallow zone, the selection of a shallow reflection horizon was made on the basis of data quality and convenient mapping level. The reflection chosen for this horizon became too shallow to map toward the Anglesea sector, so a horizon break was effected and a deeper event was mapped in that area. This one in turn became too shallow on line A-1 as it neared a tie with the Anglesea well. Thus, no reliable identification of this horizon was possible. In the Anglesea sector the horizon goes from a possible outcrop to a depth of approximately 3000 feet. East of the horizon break it varies from less than 1000 feet to almost 3000 feet in depth.

b. Basal Tertiary Horizon

This horizon was initiated by selecting the deepest event displaying satisfactory continuity and signal strength. When extended to the Anglesea sector, the horizon was found to be near the Eocene coal series in the basal Tertiary zone as shown at the Anglesea well. This identification was supported by recurring evidence that the mapping horizon was overlying an unconformity such as the one known to exist between Tertiary and Mesozoic strata. On many of the records a "dead" zone follows the strong reflection. The lithologic significance of this zone is questionable since it can be at least partially attributed to AVC action resulting from the high energy level of the reflection.

The horizon varies from a depth of approximately 1000 feet to a maximum depth of almost 10,000 feet.

c. Pre-Tertiary Dip Segments

Portions of lines A-2 and A-4 in the Anglesea sector revealed strong dip reversals at pre-Tertiary levels. These dips are shown on a map which is limited to this sector. Datum values represent a phantom horizon drawn in the zone of greatest concentration of reflected events on each line. Pre-Tertiary reflections were obscured by multiples over the remainder of the area to such an extent that no horizon of sufficient reliability to be of value could be constructed.

3. Structural Features

a. General Considerations

The area surveyed consists of two major features: an anticlinal trend extending southeasterly from Anglesea, and a major depositional syncline referred to as Bass Basin.

According to the log of the Anglesea well, which is located just north of line A-1, 1900 feet of Tertiary section (primarily coal) is measured. The remaining section to total depth of 10,500 feet is Mesozoic. A strong band of shallow reflections, correlating in time to the depth of the Tertiary at the Anglesea well, is found on line A-1. The deepest horizon initiated in the Bass Strait Area, and subsequently called the Basal Tertiary Horizon, tied into this band of energy when that horizon was extended to the Anglesea sector.

In the center of the Bass Basin the thickness of the Cenozoic section has been mapped to a depth in excess of

2.100 seconds. Since scattered evidence of a pre-Tertiary section is found near the edges of the basin, it would then seem likely that this deeper section continues to thicken toward the basin. Consequently, a pre-Tertiary section of considerable thickness must also be present in the center of the basin. However, multiples of the shallower events obscure this energy over the majority of the prospect. Evidence of this pre-Tertiary section undisturbed by multiples can be seen best on lines B-10 (1105-1040), B-18 (44-60), A-2 (15-33), and A-4 (03-54). A print of the record section on line B-10, shot points 1053-1105, accompanies this report. On this section can be seen deep reflections showing steep northwest dip and two down-to-the-coast faults of considerable magnitude which appear to die out in the Mesozoic section.

Faulting constitutes the main structural deformation in Bass Basin. Vertical displacement of the faults was determined by loop misclosure and strong energy band correlation. Faulting tends to die out rapidly in the Tertiary and none appears at the shallow horizon. Evidence indicates faulting below the basal Tertiary level to be frequent and more complex than at the shallower levels. Although the individual fault crossings are based on fair to good evidence, alignment of the faults was loosely controlled. Therefore, the fault pattern as seen from the Basal Tertiary Horizon is largely conjectural. More detailed control would probably reveal a more systematic arrangement. In order to avoid over-complication of the structural picture no throw was shown on the smaller faults or those considered only possible.

Two anticlinal trends were mapped on the north side of the basin. The alignment of the major trend is northwest-southeast across Maps 1, 2, and 3. Features lettered "A" through "E" are located on this ridge. The other trend, consisting of features "F" through "I", roughly parallels the first. Features "E" and "I" are trending west and southwest into features "D" and "H", suggesting a high area to the east and north of Bass Basin. It is conceivable that this trend continues to the east.

Two definite unconformities are present throughout the entire area. The minor unconformity, as evidenced by up-dip pinching out of deeper reflections, lies between the shallow horizon and the basal Tertiary horizon. This unconformity is probably within the Miocene section. The second and major unconformity is immediately below the basal Tertiary zone. The surface of this unconformity is usually very rough and irregular, suggesting a long period of emergence and erosion, such as occurred at the close of the Mesozoic Era. Along the southwestern and northeastern limits of the area this major unconformity suggests a Tertiary section resting directly on basement. This is supported by known surface geology of nearby islands as well as the results of single spread refraction shots taken where the section noticeably thinned. Since these were shot in one direction only, the computed velocities and depths are only approximations. The depths to the high velocity refractor, assumed to be basement, are posted on the Basal Tertiary Horizon map.

Numerous local anomalies were encountered over the area in the section between the shallow horizon and the base of the Tertiary. It is suggested that several of these features are limestone reefs, since reefs are known to be present in the Eocene and Oligocene exposures of nearby islands. Most of these features are expressed as dip reversals at the shallow level while an apparent velocity high is their major effect at depth. Line B-3, near shot points 27, 42, and 61 offers the best examples of these reef-type features. Other local anomalies, differing in appearance from the hypothetical reefs, are believed to be intrusive bodies such as dikes or plugs, with or without associated sills and flows. Their effect is usually confined locally and their role in regional structure building is considered minor. All of these anomalies are marked on the Basal Tertiary Horizon map.

A zone of erratic dips within the Tertiary section was noted in several places throughout the area. This zone often reached a thickness of 300 milliseconds and had no relationship to or noticeable effect on dips above or below this zone, but the very nature of the erratic converging and diverging of reflected events and their seeming truncation at the upper and lower limits of the zone made mapping of such a horizon unfeasible. No satisfactory explanation was found for this zone of anomalous dips. However, since they had no effect on surrounding events, their importance to the interpretation was considered negligible. The best example of this zone can be seen on line B-14, shot points 135 through 156.

b. Anomalous Features

(1) Feature A

Feature A is located on Map 1 near the center of the Anglesea sector. As contoured, the area of closure is approximately 10 by 22 miles with a structural relief of approximately 650 feet at the basal Tertiary level. Ample isochronous thinning is noted over the structure. Though very loosely controlled, this feature is based on good reflection data at both mapping horizons and is considered to be the most attractive seismic lead of the Bass Strait-Anglesea Area.

Pre-Tertiary events appearing on lines A-2 and A-4 show strong dip reversals. The arching on line A-2 coincides with that at the shallower levels, but on line A-4 there is only a very slight expression at the basal Tertiary horizon of the considerable arching at depth. The relationship between these deep reversals was not determined because the pre-Tertiary reflections on lines B-3 and B-5 were obscured by multiple reflection interference.

The water depth over this feature is approximately 240 feet.

(2) Feature B

This feature is located on Maps 1 and 2 at the northwest end of line B-11. The reversal of dip on line B-11 is based on good data. The contoured closure at the basal Tertiary level is speculative, due to the loose control in this area. A definite relationship between lines B-11 and B-22, as well as more control to the northeast is needed to confirm the presence of this closure and to define its extent. Water depths in this vicinity vary from 240 to 250 feet.

(3) Feature C

Feature C is located on Maps 2 and 3 near the intersection of lines B-12 and B-11. This feature is on a nosing trend from Feature B and is dependent on faulting of this nose for its closure. For this reason it is less attractive than others in the area. An intrusive body is apparent at depth under this feature and may possibly have some bearing on its value as a prospective trap. Closure with an areal extent of roughly 3 by 3 miles is contoured. The water depth is approximately 220 feet.

(4) Feature D

This small feature is located on Map 3 on the same nosing trend from Feature B. Closure, based primarily on 40 milliseconds of dip reversal on line B-11, is highly speculative and lies in about 225 feet of water.

(5) Feature E

This speculative feature is located on Map 3 between the northeastern end of line B-13 and line B-24. It is shown on the upthrown side of a down-to-the-south fault and is based on a conjectured relationship between dip reversals on lines B-13 and B-24. Controlling data on the latter line are considered reliable while that on line B-13 are questionable. The shallow horizon shows a southeast nosing trend across this possible feature. The water depth is approximately 230 feet.

(6) Feature F

This fault closure is located on Maps 2 and 3 north of the intersection of lines B-12 and B-20. Good reversal on line B-12 allows speculative contouring of this feature. As shown, a closure of 3 by 10 miles appears on the downthrown side of a fault. Structural relief of 150 feet is possible. The water depth is about 225 feet.

(7) Feature G

This possible closure, located on Map 3 near line B-1 shot point 30, is based on a good dip reversal on that line. Closing west dip is lacking and the feature may be no more than an extension of Feature F. This possible feature lies in 235 feet of water.

(8) Feature H

Located at the intersection of lines B-2 and B-21, this feature is based on good dip reversals on both lines. As contoured, the closed area is about 5 by 14 miles with a structural relief of 260 feet. However, the separation between this feature and Feature I to the northeast is questionable and is constituted primarily by a fault downthrown to the southwest. The water depth is 230 feet.

(9) Feature I

This feature is located near the intersection of lines B-11 and B-14 on Map 3. Closure of 5 by 6 miles in areal extent and a possible 325 feet of vertical relief are shown. This is based on good dip reversals on lines B-2 and B-21. Further control to the northeast is needed to fully define the limits of this closure. An alternate interpretation relating these dip reversals with the arching on line B-24 near shot point 68 is possible. The fault cutting the southeast flank is small, showing possibly 100 feet of throw, but is based on good evidence. The fault cutting the northwest flank near shot point 148, line B-11, is questionable and could be associated with a possible intrusive body evidenced near shot point 150. Fault alignment in this vicinity is largely uncontrolled and must be considered questionable. This feature lies under 235 feet of water.

(10) Feature J

Feature J is located at the intersection of lines B-10 and B-12 on Map 2. A closing area of 6 by 12 miles with structural relief of 325 feet is contoured. Closing dip in four directions, as shown on lines B-10, B-12, and B-22, is reliable, but because of lack of control the areal extent of this feature is speculative. The water depth is 185 feet.

(11) Feature K

Located on Maps 3 and 5 near the intersection of lines B-3 and B-20, this structure appears on the upthrown side of a fault downthrown to the southwest. Closure, including the fault, has an areal extent of

4 by 8 miles and vertical relief of approximately 400 feet. Arching on Lines B-3 and B-20 is based on good data, and the fault evidence is good. The water depth is 185 feet.

(12) Feature L

Feature L, located near the intersection of lines B-16 and B-19, is speculative as to closure but is considered to be a seismic lead. An anomalous trend is strongly suggested by dip reversals on lines B-5, B-16, and B-19. This portion of the area appears to be severely faulted and data quality in general is poor to questionable. The water depth is 147 feet.

4. Conclusions and Recommendations

The thickness of the sedimentary section in Bass Basin is sufficient to make the area attractive. No very large anticlinal features were mapped in the basin and the contouring in many cases is largely speculative. However, the possibility exists that some features could be larger than shown and that other sizable anomalies might have been left unsurveyed by the large loop reconnaissance. Evidence of a thick pre-Tertiary section in the basin makes even small closures prospective traps for the accumulation of petroleum, since marine Devonian, Permian, and Cretaceous have been suggested as source beds in mainland production. Faulting constitutes the main structural deformation and fault trap accumulation is a definite possibility. Stratigraphic traps in the form of updip pinchout are indicated in many places around the margins of Bass Basin. The extent of the Tertiary reefs is not known because of very loose control but the possibility of petroleum in these reefs should not be overlooked.

Anticlinal features A and B in the Anglesea sector are considered to be the most promising leads in the surveyed area, although the latter is highly speculative. A Tertiary section of 1900 feet and pre-Tertiary of at least 8600 feet is measur ed in the Anglesea well. On line A-1 leading away from this well, the Basal Tertiary Horizon dips steeply to the south and is faulted into a basin or trough. Considerable updip wedging toward the well is noted. From this it can be assumed that an extremely thick Tertiary as well as pre-Tertiary section is present in the seaward extent of the Anglesea trough. Apparently folding has taken place in the trough as well as the area to the southeast and a more detailed seismic program is definitely warranted.

In several places throughout the surveyed area, pre-Tertiary reflections show dip reversals suggesting additional features at depth which are not expressed at the basal Tertiary level. Of particular interest in this respect is the block faulting revealed by line B-10 between the main body of the area and the northeast coast of Tasmania. The extremely steep dips encountered at depth and the dip reversals resulting from draping of pre-Tertiary beds over these deep faults make this sector worthy of further investigation.

In the event of further seismic exploration in this area, a shooting technique providing at least 300% overlapping subsurface coverage and subsequent stacking of tapes is recommended to minimize the interference of multiple reflections and improve the quality of deeper reflections.

C. South Australia Area

1. Data Quality

(a) Map 1

Although general record quality is rated poor in this area,the reflected events on which the maps are based are generally sufficiently strong in comparison with the normal energy level on the records so that data quality can be considered fair to good except in the vicinity of faults. Over the north half of the map, however, reflection quality deteriorates because of the shallow reflection times in comparison with the spread length.

(b) Map 2

The quality of data on this map is generally good at the deeper horizon level north of the formation break possibility and poor to questionable across a band approximately eight miles wide parallel to and south of the break. South of this band, the data quality is considered fair to good. At the shallow level, data quality trends are approximately similar to those described at the deeper level. However, because of lack of a continuous reflecting horizon at the shallow level, data quality is considered generally inferior.

(c) Map 3

The data quality is considered good on this map at both levels mapped although affected by extensive faulting.

(d) Map 4

On this map, data quality is considered fair to good at both levels across the north half of the survey despite the effect of severe faulting. Reflections below the deeper mapped level are generally obscured by multiples of shallower reflections. These multiples were clearly identified by the residual moveout curvature on the corrected long spread records. In the southwest corner of the survey, the record quality was found to deteriorate primarily because of strong water bottom multiples which often were observed to completely override primary reflected energy. Additional causes of poor reflection quality are believed to be connected with steep, erratically dipping shallow beds and increasing intensity of the faulting.

(e) Multiple Reflection Identification

Most multiple reflections were clearly identified on the corrected long spread records by the residual normal moveout of the multiples. On the south corner of the survey, however, the sea bottom multiples are believed to be added to multiples of reflecting horizons, with the resulting effect that the moveout curvature of the multiples varies considerably depending upon the origin of the multiples and resultant travel path. As these complex multiples are often found mixed with possible primary reflections, selection of the proper velocity function was problematical, and the distinction between multiples and primary reflections was often doubtful.

(f) Tape Stacking

An attempt was made to improve the data quality by stacking the tapes obtained from adjacent overlapping long spread profiles, thus providing 200% subsurface coverage. On the stacked sections some improvement was observed in the cancellation of reflection multiples and random noise, but little if any improvement was observed in the recording of primary reflected energy. This has often been found to be the case in comparisons between 200% long spread stacking and 100% short spread coverage. Normally, considerable improvement is observed with 300% or more subsurface coverage.

2. Origin and Extent of Structural Horizons

a. Oligocene Phantom Horizon

As no continuous reflecting horizon was observed above the reflected event attributed to the basal Tertiary, the mapping level for this horizon was established at the shallowest reflection time where sufficient reflected energy was believed available to provide a qualitatively reliable phantom map over the largest possible part of the survey. From information obtained at the Nelson and Robe bores on land near the southeast corner and along the northeast border of the prospect, respectively, this horizon is believed to approximate the base of the Oligocene. The phantom ranges from a record time of less than

200 milliseconds (-630 feet) in Lacepede Bay on Map 1 to more than 900 milliseconds (-3350 feet) in the southern corner of the survey on Map 4. On the southwest edge of the survey, deep troughs are mapped with indicated depths in excess of 5000 feet. The phantom was not extended north across Lacepede Bay because of insufficient data due to the thin sedimentary section. Off Cape Jaffa the horizon could not be followed and is believed to pinch out against the flank of a basement ridge.

b. Basal Tertiary Horizon

For this horizon a reflected event was selected which, although complicated by faulting, is believed to extend over most of the survey. This event was generally identified by greater reflection strength in comparison with other events and by its position on the record below nonconforming reflected energy. From information obtained at the Nelson bore, this horizon is believed to represent the approximate base of the Tertiary. However, in the Robe bore area it appears that the reflection mapped correlates with a lower Cretaceous or Jurassic event. A possible formation break is drawn across Map 2 between the area in which the event mapped is believed to represent the approximate basal Tertiary and the area in which the reflected event may represent lower Cretaceous structure. North of the indicated possible break, the horizon ranges from approximately 200 milliseconds (-800 feet) on Map 1 to below 1700 milliseconds (-7700 feet) on Map 2. South of the break possibility, time values range between 290 milliseconds (-930 feet) and 1592 milliseconds (-7575 feet) in the south corner of Map 4.

c. Other Horizon Possibilities

It is believed that the two horizons selected adequately portray structural relief down to the lower level mapped and that any additional shallower map would be superfluous. At deeper levels scattered good reflected energy is recorded on several lines, but available control is believed insufficient to correlate these events at the present time.

3. Structural Features

a. General Considerations

North of Cape Jaffa a comparatively high, flat shelf covers most of Map 1. This shelf is limited on the east by a basement high trend which extends in a general north-south direction to the Lucindale fault zone and then curves westward. The limits of the shelf were not surveyed toward the north or west. Although the refractions obtained from the single-end profiles indicated approximately 2500 feet of sedimentary section on this shelf, it should be taken into consideration that the most informative of these profiles were taken in the area which has been interpreted as a basement high trend and are not necessarily applicable to the remaining area. In fact, considerable data exist which indicate a deeper section over the greater part of the map with values ranging between 3000 and 5000 feet and possibly greater in troughs and grabens.

South of the Lucindale fault trend, a basin approximately 16 miles wide is mapped. This basin is bounded on the north by the above fault and on the south by a high trend extending across the surveyed area in an approximate east-west direction from the area around Beachport. Sediments in this basin are believed to exceed 10,000 feet. South of the basin a series of trends are mapped roughly paralleling the coast. In general, the shallow horizon tends to dip toward the south or southwest, while the deeper horizon tends to dip toward the land (northeast) and is faulted down toward the sea.

In addition to the features considered of primary interest and lettered "A" through "R" on the contoured maps, several leads are indicated along the edges of the surveyed area but are not discussed in detail since closure is uncontrolled in one or more directions.

b. Faulting

In general, it is suggested that block faulting on a large scale took place during Cretaceous time in the south part of the surveyed area, corresponding to the seaward extension of the Gambier Sunklands. Faults generally trend roughly parallel to the coastline and are downthrown toward the sea. Faulting tends to die out rapidly in the Tertiary, and as a result the majority of faults mapped in the deeper horizon are not observed at the shallow level. Between Beachport and Robe the sedimentary section, as indicated by the depth of reflection data obtained, thickens considerably. A fault zone consisting of two parallel faults is mapped, across which the deeper horizon is dropped approximately 5000 feet to the north. Because of the large amount of throw suggested by this interpretation, a possible formation break is indicated, although the correlation across the fault zone is based on what is considered a reasonably logical correlation of those reflected events displaying the greatest similarity.

In the vicinity of Cape Jaffa a series of block faults, downthrown to the south with steep south dip, is mapped approximately in line with the Lucindale fault. North of this series faulting is less extensive and no definite trends are determined because of loose control.

Indications of possible thrust faulting are observed in the southern corner of the survey, but data quality is too poor to permit a positive evaluation of these indications.

c. Anomalous Features

(1) Feature "A", Map 1

This structure is located in the northern part of the map in Lacepede Bay, approximately 15 miles off shore. Although the final closed area cannot be accurately determined because of lack of control on the east, the closure as tentatively mapped exceeds 80 square miles and is based on fairly good reflection data. Structural relief may be found to exceed 400 feet. Water depth over this feature is 130 feet.

(2) Feature "B", Map 1

This anomaly is mapped approximately 3 miles west of the basement ridge paralleling the eastern edge of the map. The contouring is based on slightly more than 50 milliseconds (200 feet) of anomalous northeast dip in an area where dips were found to trend southwest. As no cross control is available, structural relief and extent are conjectural. The water depth is about 115 feet.

(3) Feature "C", Map 1

This lead is located approximately 20 miles southwest of Feature "B" on the southern part of the shelf discussed previously. As tentatively mapped without control to the northwest, two apices are contoured with more than 40 square miles included within the closed area. Indicated structural relief is approximately 300 feet. A water depth of approximately 140 feet is shown over this lead.

(4) Feature "D", Map 1

This high trend is located approximately 10 miles southwest of Feature "C" and corresponds roughly with what is believed to be the westward extension of the basement ridge north of the Lucindale fault.

The contouring is based on more than 100 milliseconds (400 feet) of anomalous dip on line SA-2 at the deeper level and a corresponding, though smaller, dip reversal on line SA-10. Based on very poor reflection data at the shallow level, approximately 150 feet of reverse dip is indicated. Dip trends at the deeper level are considered reliable. The water depth is 240 feet.

(5) Feature "E", Map 2

This feature is located at the northern edge of the Gambier Sunklands approximately midway up the north flank of the basin. The contouring is based on more than 60 milliseconds (250 feet) of reverse northeast dip on line SA-3 at the shallow level of which approximately half is believed to be based on reliable data. At the deeper level less dip is mapped but the total closure is increased by a small fault. As control is too loose to delineate the structure, two possible interpretations have been mapped. At the shallow level the apex is contoured northwest of line SA-3, while at the deeper level the apex is mapped on the opposite side of the line. The extent of closure and structural relief are obviously hypothetical. This feature lies under 160 feet of water.

(6) Feature "F", Map 2

This structural lead is mapped near the center of the basin between the Lucindale fault and the indicated possible formation break. The contour projections are based on a wide anticlinal trend on line SA-12 which has been correlated with a similar trend on line SA-10. At the shallow level more than 300 feet of dip reversal is established across approximately 12 miles of line SA-12 by reflection data which is generally considered reliable. This reversal is correlated with a dip reversal of more than 150 feet across 8 miles on line SA-10. The contouring projected from these dip trends indicates the possibility of more than 150 square miles of closure at the shallow level. At the deeper level the basic trends are similar, although complicated by faulting. Reflection data indicate a sedimentary section more than 10,000 feet thick in this area. A water depth of 90 feet is shown.

(7) Feature "G", Map 2

This elongated structure is located on a trend along the south edge of the indicated possible formation break. At the deeper level the contoured closed area exceeds 15 square miles and the indicated structural relief exceeds 250 feet. At the shallow level less than 70 feet of vertical relief are estimated. Contouring is based on fair to poor data at both levels. The water depth is about 100 feet.

(8) Feature "H", Map 2

At the deeper level this feature is mapped as a structural lead southwest of the detailed area near the intersection of lines SA-4 and SA-10. The contouring is based on more than 600 feet of southwest dip of line SA-10 at both levels and approximately 400 feet of southeast dip at the deeper mapped level on line SA-4. Dip projections are considered reliable except at the shallow level on line SA-4 where reflection data is questionable. The north closure is based on a fairly good fault correlation at the deeper level and poor dip information at the shallow level.

Approximately four miles north of this lead a closed area is tentatively mapped at the shallow level over a horst at the deeper level. At both levels the contouring is based on reflection data which is considered questionable. A water depth of 340 feet further detracts from the value of this lead.

(9) Feature "I"

This lead is located on line SA-12 approximately due west of Beachport and is believed to correspond with the offshore extension of the Beachport gravity high which has been interpreted as an igneous intrusion. On the south flank of the structure dip is observed increasing with depth from approximately 500 feet at the shallow level to more than 800 feet at the deeper horizon level. The north flank is poorly delineated at both levels and is indicated by a poorly defined fault at the deeper level and approximately 200 feet of questionable dip at the shallow level. The water depth in this vicinity is 75 feet.

(10) Feature "L", Map 2

This anticlinal feature is located on the seaward edge of the survey area approximately two miles west of the intersection of lines SA-5 and SA-10 on a trend extending across the survey in an a approximate east-west direction from the coast. The closed area, as contoured, measures approximately 15 miles by 5 miles. Structural relief is estimated at more than 800 feet at the deeper level and 500 feet at the shallow horizon. Although total closure to the southwest is not controlled, it is believed that the contour projections are made in a logical manner on the basis of the data available. The reflection data upon which both levels are mapped are considered reliable to within one cycle. The water depth over the crest of this feature is about 240 feet.

(11) Feature "J", Map 3

This lead is located on the landward edge of the survey approximately south of Beachport on a northwest-southeast trend extending across the surveyed area. Because of loose control, it is not believed possible to determine if the structural apex is located north of line SA-13 as contoured at the shallow level or south of the line as tentatively mapped at the deeper level. The trend along which the closure is contoured is based on approximately 400 feet of dip reversal on line SA-13 which has been correlated with approximately 320 feet of dip reversal on line SA-5. This feature appears more significant at the shallow level than at the deeper level due to the trend at the deeper level rising toward the west. Dip information is considered reliable on line SA-13 and fair on SA-5. This lead appears in about 75 feet of water.

(12) Feature "K", Map 3

This anomaly is located on the northeast edge of the survey approximately three miles southeast of Feature "J". As tentatively contoured, the structure is elongated on an east-west axis. The contoured interpretation is based on approximately 800 feet of southeast dip which is considered reliable at both levels. The closure on the northwest flank instead is based on a questionable fault projection. Although it is believed that correlations across the fault have been made in a logical manner, the fault is not observed on other lines and the strike is therefore uncontrolled. Contouring is without control to the northeast. The water depth is approximately 75 feet.

(13) Feature "M", Map 3

This tentative lead is located approximately 15 miles southwest of Feature "L" on the same general trend. The contouring is based on weak dip reversals on lines SA-6 and SA-13 and complicated by extensive faulting and without control along the trend axis. A water depth of 280 feet is shown.

(14) Feature "N", Map 3

This possibility is located on a trend approximately nine miles south of the above trend. As contoured, the closed area is approximately 10 square miles but closure is uncontrolled along the trend axis either toward the east or to the west. Structural relief is shown as about 200 feet at the shallow level while at the deeper level the apex is off the survey area and contours have not been closed around the lead. Water depths in the vicinity of 500 feet make this possible feature of little immediate interest.

(15) Feature "O", Map 3

This structural feature is located within the loop formed by lines SA-7, SA-10, SA-13, and SA-15. At the deeper level the closed area is believed to exceed 30 square miles, while at the shallow level a closure of approximately 15 miles by 7 miles is indicated. At both levels the maximum extent of the closed area cannot be determined because of lack of control on the northeast. It seems probable that structural relief at both levels will exceed 400 feet although at the deeper level the picture is complicated by extensive faulting. A water depth of 200 feet is shown over the crest of this feature.

(16) Feature "P", Map 4

This lead is located on a trend approximately paralleling the coast, intersecting lines SA-7 and SA-16. The structural apex is mapped between these lines but closure along the trend is not controlled. As the deeper horizon mapped in this area generally dips toward the land and is faulted down toward the sea, closure at the deeper level is primarily against faults, while closure at the shallow level is primarily structural with evidence of draping over the deeper faults. At the deep level the combined structural and fault trap closure exceeds 40 square miles as tentatively contoured. At the shallow level it appears probable that the closed area will be continuous with Feature "O". Approximately 500 feet of closed structural relief are indicated at the deeper level. The water depth over this lead is about 280 feet.

(17) Feature "Q", Map 4

Although this feature, which is located near the intersection of lines SA-14 and SA-16, is mapped as a relatively small anomaly on the general trend along which Feature "O" is located, it appears likely that closure at the shallow level is continuous with Features "O" and "P" in which case the total closed area would exceed 300 square miles. As with Feature "P", the closure at the deeper level is primarily against faults. As tentatively contoured, combined structural and fault trap closure at the deeper level exceeds 70 square miles. The water depth is approximately 100 feet.

(18) Feature "R", Map 4

This tentative lead is based on indications of a structural high trend near the surface on line SA-9 between lines SA-8 and SA-17. Although information at the mapped levels is considered unreliable because of disturbance from water bottom and other multiples, a strong band of reflected energy was recorded from a shallow horizon above the mapped levels, and dip trends from this reflected event are included on the Oligocene phantom map. Approximately 1100 feet of structural relief is indicated on line SA-9 across this lead. Further detail is believed required to evaluate structural possibilities of this lead. The water depth in this vicinity is about 250 feet.

4. Conclusions and Recommendations

Although the contouring is based on loose control and the maps are considered generally incomplete, possibilities have been established for structural, stratigraphic, and fault traps surrounding or within a sedimentary basin more than 10,000 feet thick. Further detailing appears warranted, especially south of the Lucindale fault in the Cape Jaffa area, with particular emphasis on the larger structural leads indicated by the reconnaissance survey. Because of the extensive faulting observed, attention should be given to the general fault strike trend in planning the detail survey in order that lines will cross the faults at approximately right angles. The indicated direction for the lines is roughly normal to the coast line. Lines should extend as close to shore as possible, and it is believed that some extensions southwest into deeper water would add to the general basin interpretation.

While possibilities of the area northwest of Cape Jaffa appear limited by the thinness of the sedimentary section as indicated by the survey, the position of this shelf in proximity to the deeper basin at the north edge of the Gambier Sunklands might increase interest in structural traps in this area because of up-dip migration. In this area a detail net is recommended, as very few definite fault or dip trends were established. For a detailed interpretation of this shelf, it is believed desirable that the detail be extended seaward and that a few reconnaissance lines be shot as far seaward as results can be obtained or deep water is encountered. It is recommended that efforts be directed toward improving the record quality in this area through more refined techniques. At least one line employing 600% subsurface coverage would provide a basis of comparison for establishing an adequate survey program as well as provide an additional basis for determining the thickness of the sedimentary section west of the basement high trend.

To explore the possibility of stratigraphic traps on the north flank of the Gambier Sunkland sedimentary basin, detail lines laid out in the direction of maximum dip would be most effective. It is believed that sufficient information was obtained from the reconnaissance survey to adequately establish this detail program.

Because of the presence of strong multiple energy over most of the Gambier Sunklands, especially at times greater than the deeper horizon mapped, in addition to areas of poor record quality, it is recommended that consideration be given to a shooting technique that would allow at least 300% subsurface coverage over this part of the survey. Northwest of Cape Jaffa, instead, consideration should be given to a shorter spread length because of the possible thinness of the sedimentary section. Shot point spacing of 400 meters necessary for the 300% subsurface coverage would probably be sufficiently short for adequate delineation of this portion of the area.

VII. FIELD PARTY PERSONNEL

A. Office

V. C. Boyd, Jr.	Operations Manager
J. A. Dees	Seismologist
A. Brenda	Computer
J. S. Hull	Computer Clerk

B. Recording Boat

J. A. Rasmussen	Coordinator
C. R. Dixon	Assistant Coordinator
A. C. McEachern	Observer
R. Stansbury	Observer
J. Miller	Assistant Observer
J. Dawson	Assistant Observer
L. Cooper	Observer's Helper
B. Larsen	Observer's Helper

C. Shooting Boat

C. E. Rogers	Shooter
J. Vernon	Shooter
W. Kelly	Shooter's Helper
R. Gordon	Shooter's Helper

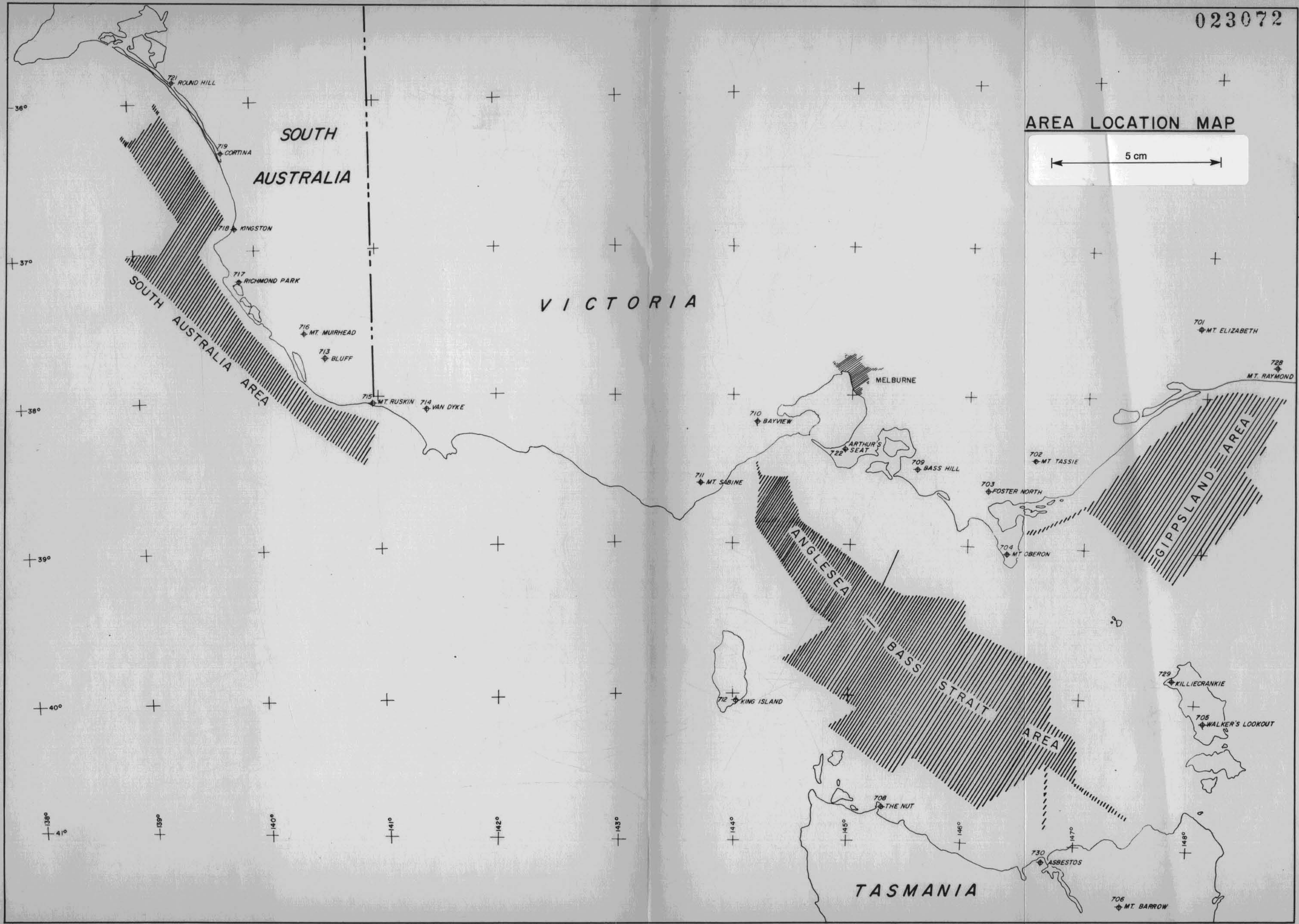
VIII. STATISTICAL DATA

	Number of Shot Points	Total Milage	Explosives Used (Pounds)	Average Charge Per Shot Point
Gippsland	2695	1005.4	124,650	47 Pounds
Bass Strait-Anglesea	4761	1775.8	172,442	36 Pounds
South Australia	1723	657.2	81,000	47 Pounds
Totals	9179	3438.4	378,092	41 Pounds

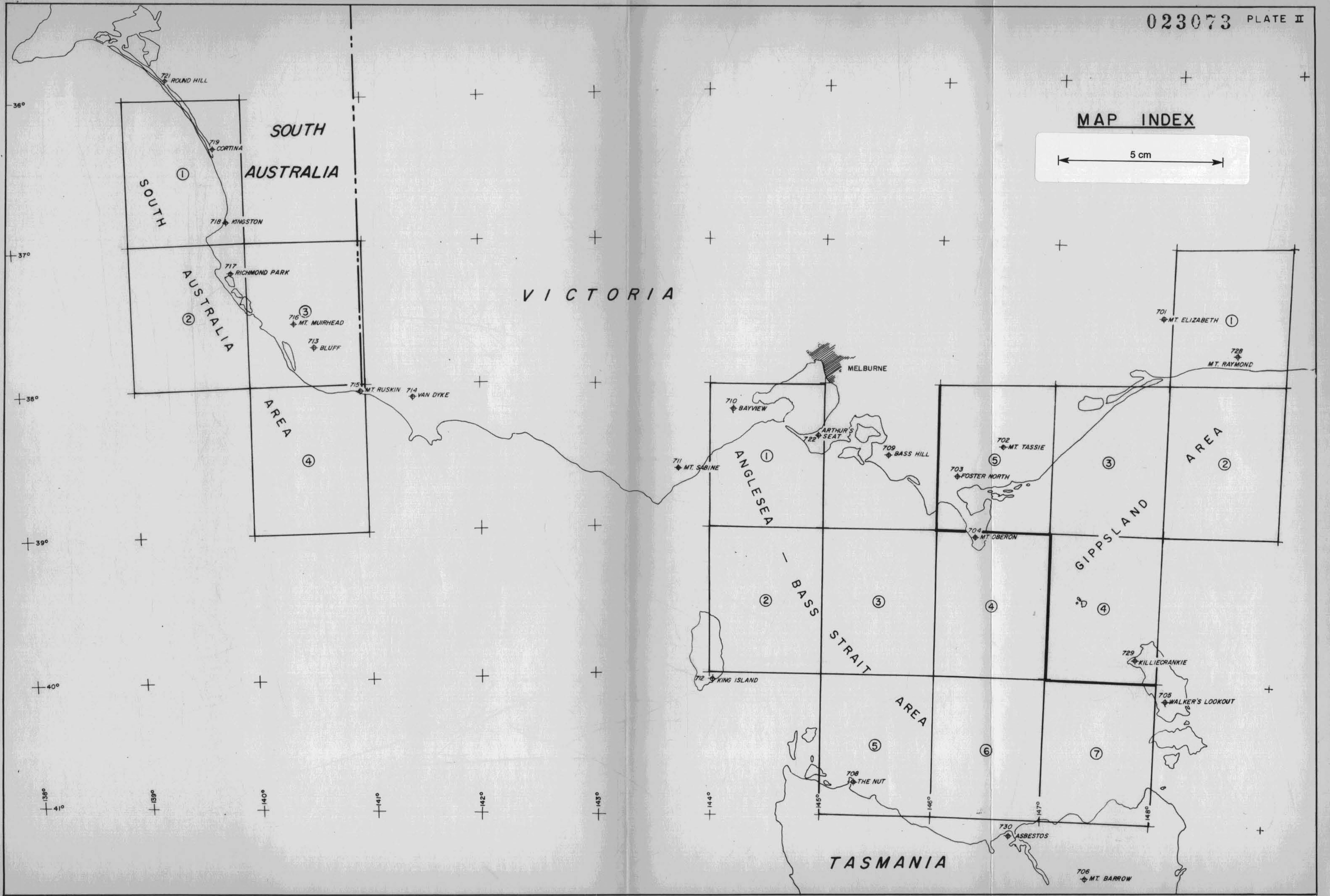
Party Chief: J. A. Dees

Supervisor: Fred J. Di Giulio

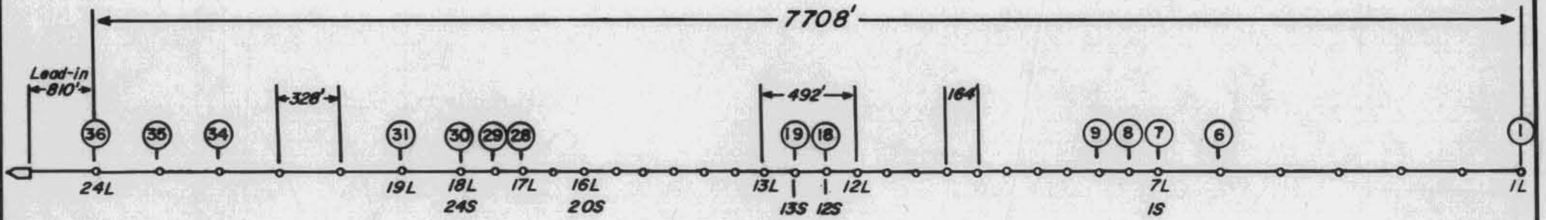
PLATE I


AREA LOCATION MAP
5 cm
SOUTH AUSTRALIA
VICTORIA
TASMANIA
SOUTH AUSTRALIA AREA
ANGLESEA – BASS STRAIT AREA
GIPPSLAND AREA
MELBURNE
721 ROUND HILL
719 CORTINA
718 KINGSTON
717 RICHMOND PARK
716 MT. MUIRHEAD
713 BLUFF
715 MT. RUSKIN
714 VAN DYKE
710 BAYVIEW
722 ARTHUR'S SEAT
709 BASS HILL
711 MT. SABINE
702 MT TASSIE
703 FOSTER NORTH
704 MT OBERON
701 MT. ELIZABETH
728 MT. RAYMOND
712 KING ISLAND
729 KILLIECRANKIE
705 WALKER'S LOOKOUT
708 THE NUT
730 ASBESTOS
706 MT. BARROW
36°
37°
38°
39°
40°
41°
138°
139°
140°
141°
142°
143°
144°
145°
146°
147°
148°

023073 PLATE II



023074



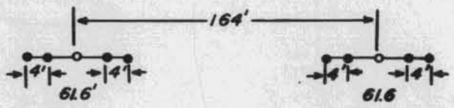
(36) Denotes cable group.

24L Denotes long cable group — Uniformly spaced except at center.

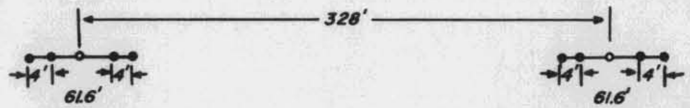
24S Denotes short cable group — Uniformly spaced.

o Denotes group center.

o Denotes seismometer.



Seismometer group layout in Short Cable

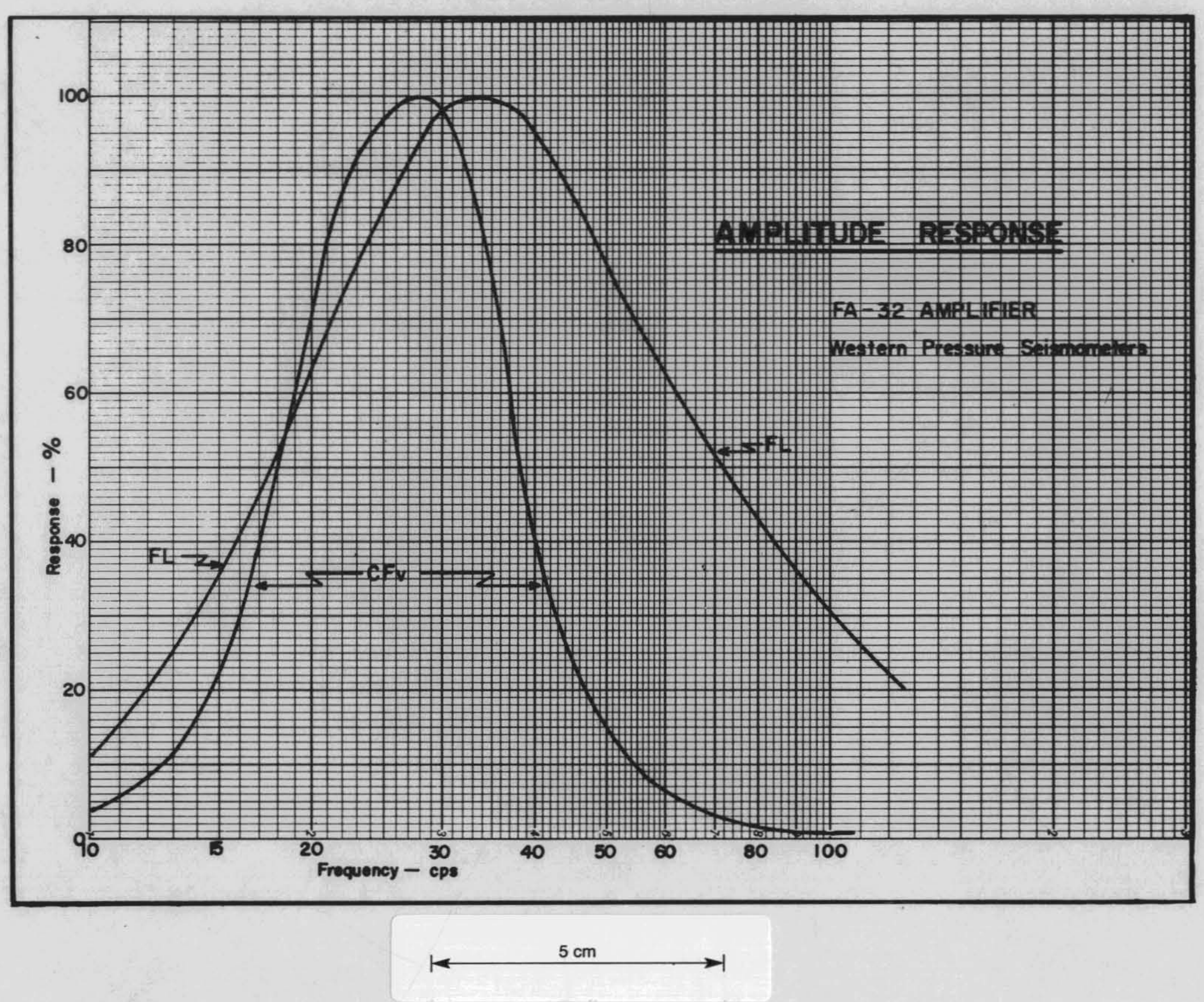


Seismometer group layout in Long Cable

CABLE DIAGRAM

Western

PLATE III


AMPLITUDE RESPONSE
FA-32 AMPLIFIER
Western Pressure Seismometers
Response — %
Frequency — cps
FL
CFv
FL
0
20
40
60
80
100
10
15
20
30
40
50
60
80
100
5 cm

023076

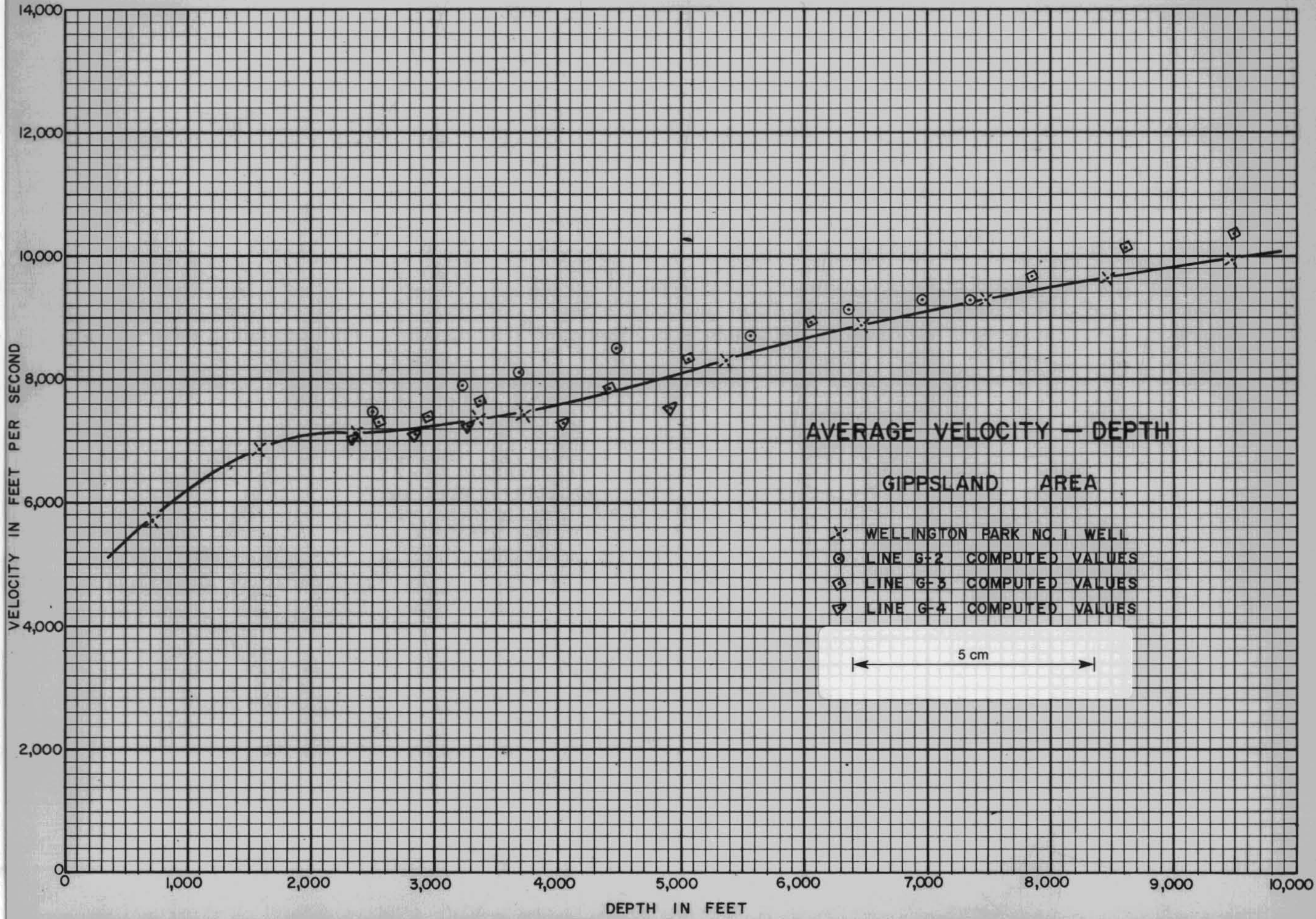


PLATE V

023077

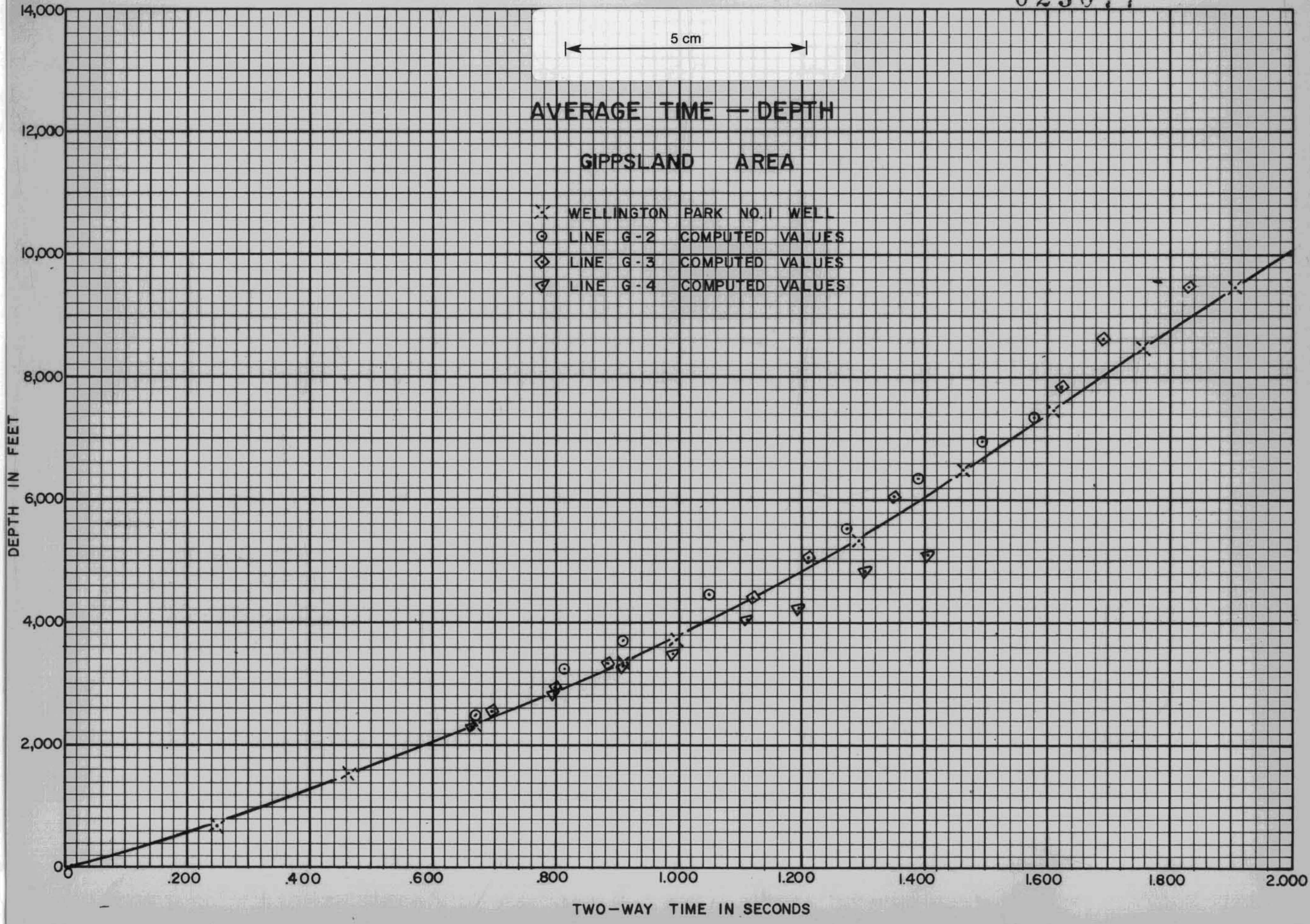


PLATE VI

023078

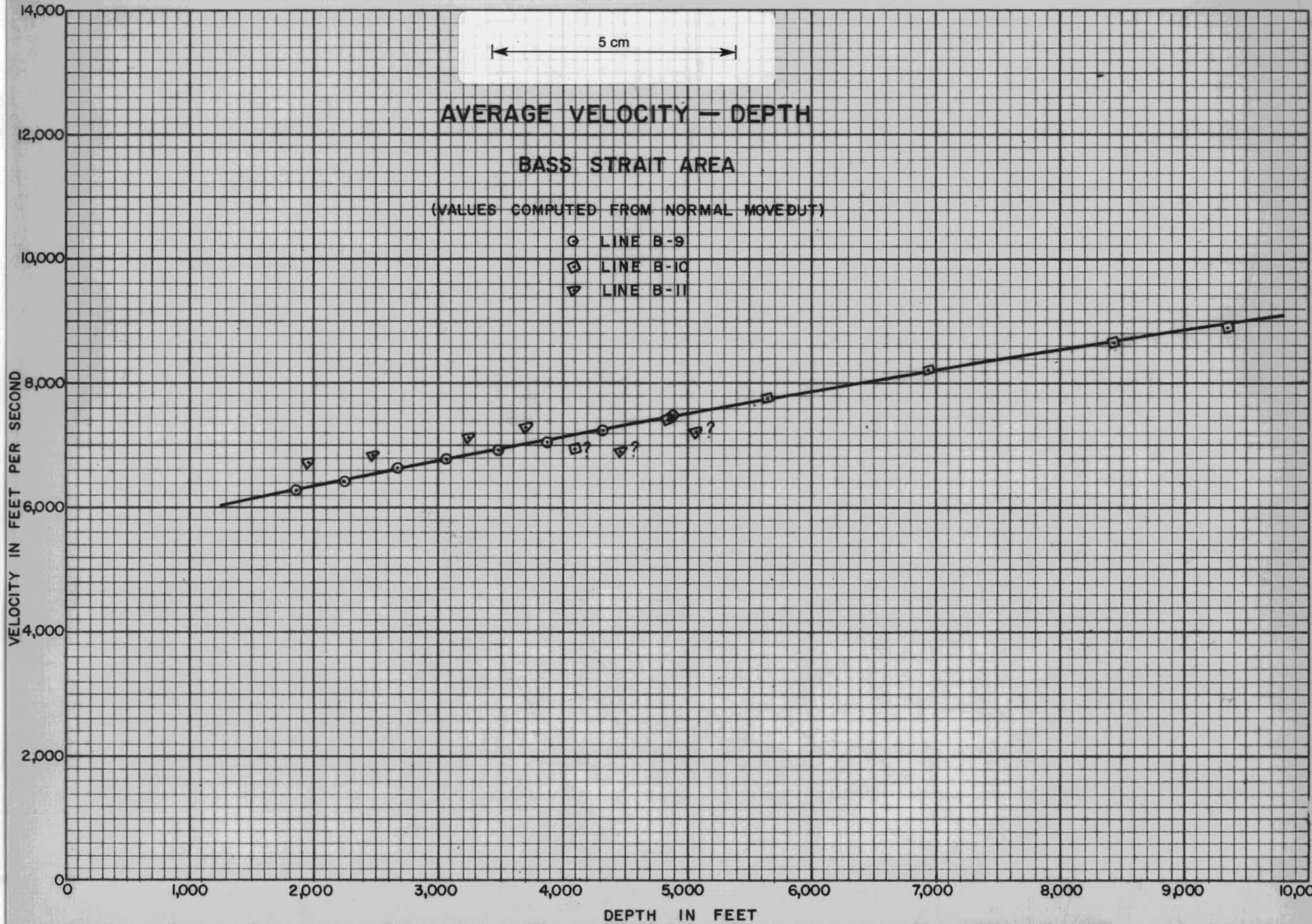


PLATE XII

023079

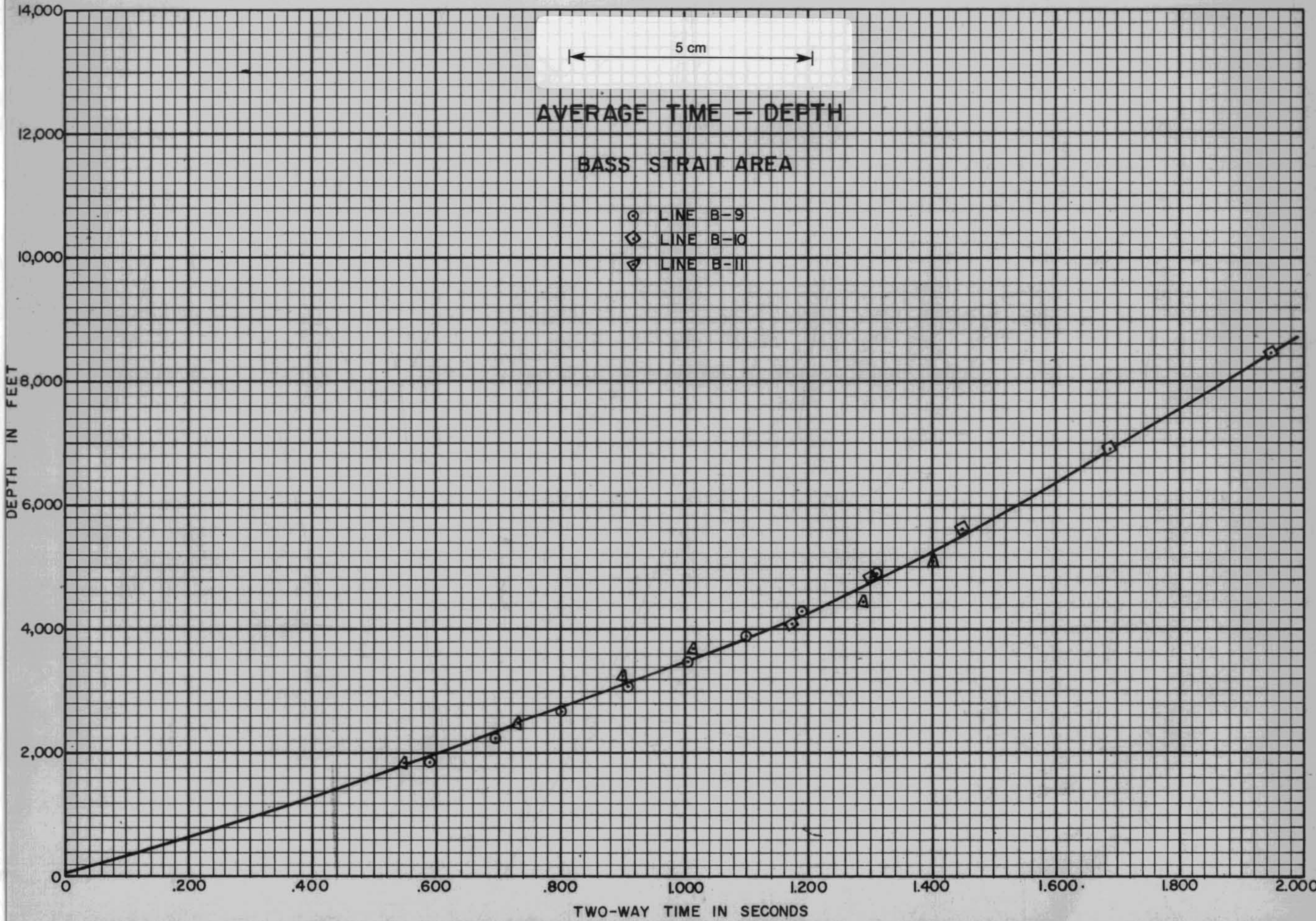


PLATE XIII

APPENDIX A

Report of Surveying Operations

By

OFFSHORE NAVIGATION, INC.

1. DESCRIPTION OF SHORAN SYSTEM

The Shoran System measures the distances of the vessel or aircraft from two base stations by measuring the time required for radio signals to travel from the vessel or aircraft to each base station and back to the indicating station (aircraft or vessel). The distances are related to the corresponding time intervals in simple manner because of the high degree of constancy of the velocity of radio waves in air.

Pulse signals originating at the indicating station in the aircraft or vessel are radiated from the indicating station transmitter, and received by one of the base stations. At this base station, the pulse is sent from the output of the receiver to the input of the transmitter, and the pulse is then retransmitted back to the indicating station. After passing through the indicating station receiver, the pulse is routed to a circuit in which its time lag, or loss, with respect to the original outgoing pulse may be determined. This time lag is indicated directly in terms of statute miles rather than units of time.

Other pulses are transmitted to the second base station, using a different carrier frequency to permit their discrimination from those intended for the first base station. These pulses are received and retransmitted by the second base station, and on their return to the indicating station they are likewise sent through circuits for measurement of the time required for their round trip. Thus the equipment provides, simultaneously, indications of the distances of the indicating station to the two base stations.

The accuracy can be expected to be within 50 to 75 feet on any one distance and the accuracy of each location or fix is dependent on the strength of the angle formed by the two arcs of distance at the indicating station. In addition, the overall accuracy of the survey is directly relative to the accuracy of the basic control used to tie in the Shoran base station locations.

2. THE AREA OF OPERATIONS

Extends roughly from Lakes entrance Victoria, over Bass Strait, offshore waters of Western Victoria, offshore waters of State of South Australia up to Lacepede Bay.

Western's base of operations was Melbourne, but Offshore Navigation's field offices were established in Bairnsdale Victoria, Launceston, Tasmania, Mount Gambier, South Australia and Geelong, Victoria.

3. Karel Kovacic, Shoran Supervisor, arrived in Melbourne, Australia, on October 29, 1962. Rex Wollen, indicator operator, Paul Gustafson, indicator operator, Charles Maloy, draftsman, Willie Watson, Base station operator, Steve Sauder, base station operator and Norman Hoffman, base station operator, arrived in Melbourne on November 5, 1962. Shoran gear arrived in Melbourne area on on November 7, 1962 and installation of indicator units aboard M/V "OIL CREEK" (recording boat) and aboard M/V "BLUFF CREEK" (shooting boat) and setting-up of Shoran camps, Mount Elizabeth, Mount Tassie and Foster North commenced at once. On November 19, 1962, boats sailed from Melbourne for Gippsland work area. Actual Shoran operations commenced on November 20, 1962 and continued through May 16, 1963.

4. All IBM preplotting was done in Melbourne. Preliminary postplotting and mapping were done in Western's Melbourne office, but final IBM recompute plots and final mapping were done in Offshore Navigation's office in New Orleans, La.

Following is a list of Shoran sites (See Table and Plate I):

MOUNT ELIZABETH: The Shoran station was erected at the trig. site. It is about 20 miles North Northwest from Bruthen, accessible by motor vehicle by "Bruthen-Omeo" Highway at Tambo Crossing. A Forestry Commission trail turns east from the Omeo Highway and leads on top of Mount Elizabeth to the trig. site.

MOUNT TASSIE: Shoran station was erected at "Aero Service Sutton's Resection" concrete and bronze marker approximately 75 feet North from the ABC Channel 2 television transmitter on Mount Tassie. It is about 22 miles South from Traralgon, Victoria, and the site is accessible by motor vehicle by good scenic road (the Grand Ridge Road).

FOSTER NORTH: Shoran station was erected at trig. site. It is about 5 miles Northwest from Foster on the South Gippsland Highway and about 1/4 mile North from the highway accessible by motor vehicle over "O'Grady's Ridge" road. It is about 100 yards west from a P. M. G. repeater station. It is accessible by motor vehicle.

MOUNT RAYMOND: Shoran station was erected at trig. site. It is about 7 miles East of Orbost, Victoria, and accessible from Princess Highway by Forestry Commission trail. It is about 1 mile South from Princess Highway. It is 100 ft. East from Forestry Commission Lookout Tower. It is accessible by motor vehicle.

MOUNT OBERON: Shoran station was erected at trig. site. It is about 2 miles East from Tidal River camp and Post Office on the Wilson's Promontory. It is accessible from Tidal River camp by a winding P. M. G. mountain road by motor vehicle up to P. M. G. building just about 350 ft. lower top of the mountain. The last 350 ft. must be manhandled up a very steep rough and rocky trail.

WALKER'S LOOKOUT (Flinders Island, Tasmania): Shoran station was erected at trig. site. It is about 10 miles North from white mark and accessible by motor vehicle by a fair mountain trail. It is about 200 feet West from P. M. G. repeater station. It is located between two P. M. G. rombic antennas.

MOUNT BARROW: Shoran station was erected at trig. site. It is about 15 miles West of Launceston (Tasmania). It is accessible by motor vehicle by a fair mountain road up to D. C. A. (Department of Civil Aviation) power house, just about 400' short of D. C. A. repeater building which is located on top of the mountain. The last 400' must be man-handled using D. C. A. "Flying Fox" (mechanized cable lift) over very steep and rocky terrain. Trig. site is about 10' Southwest of D. C. A. 150' high antenna tower.

THE NUT: Shoran station was erected at trig. site. It is about 1 mile West of Stanley (Tasmania). It is located on top of a 500' high plateau locally known as "The Nut". It is about one-half mile Northeast of the P. M. G. antenna farm. It is accessible by motor vehicle up to the P. M. G. station at the foot of "The Nut" and then have to be man-handled up a very steep slope for about 300'.

KING ISLAND (Tasmania): Shoran station was erected at trig. site. It is located on a tree-covered hill locally known as "Gentle Annie Hill". It is located on property owned by Mr. Jack Linsday, telephone number Lynwood-12. A track was cleared from the Linsday Homestead to the hill. It is accessible by motor vehicle.

BASS HILL: Shoran station was erected at trig. site. It is located about 2 miles Southwest from the village of Glen Forbes South (Victoria). It is located about 3 miles from village and post office Glen Forbes. It is adjacent to the property owned by Mr. James Easton, Glen Forbes. It is accessible by motor vehicle.

BAY VIEW: Shoran station was erected at trig. site. It is about 10 miles West from Geelong (Victoria). It is about 7 miles North Northeast from village Mount Moriac. It is on a prominent hill and marked with a standard 12' high trig. marker wood structure. It is accessible by motor vehicle.

ARTHUR'S SEAT: Shoran station was offset from the trig. site. The Shoran site is marked by an "Aero Service" brass plaque buried a few inches below the ground surface. A steel fence stake is also buried at the Shoran site as an aid to relocating the site with a magnetic compass or dip needle. It is located in Arthur's Seat Park about 3 miles South Southwest from village and post office Dromana, Victoria. It is accessible by motor vehicle.

KINGSTON: Shoran antenna was erected on top of Kingston water tower in Kingston, South Australia. Authority in charge of water tower is Mr. Martin, Regional Director of Engineering & Water Supply, Box 603, Mount Gambier, South Australia. There is only one water tower in Kingston. Shoran antenna was located 3' south of trap door on top of the water tower. Site is accessible by motor vehicle.

THE BLUFF: Shoran station was erected at trig. site. It is located about 12 miles Northwest of Mount Gambier, South Australia, and also about 4 miles Southwest of Glencoe. It is located adjacent to a Forestry Commission observation look-out tower. It is accessible by motor vehicle.

VANDYKE: Shoran station was erected at trig. site. It is about 4 miles south of Lyons, Victoria. Lyons is located on Princess Highway. Site is located on a hill, locally known as "Good Hill". It is about 200 yards east of a Forestry Commission small observation tower. There is a telephone in this observation tower. Phone number is Lyons -5-U. Site is accessible by motor vehicle.

RUSKIN: Shoran station was erected at trig. site. It is located on Victoria, South Australia, border and about 4 miles west of village Nelson, Victoria. It is on a prominent hill and marked by a standard 12' trig. marker wood structure. It is accessible by motor vehicle.

MUIRHEAD: Shoran station was erected at trig. site. It is located about 5 miles Northeast from village Millicent, South Australia. It is about 1/2 mile Northwest from a limestone quarry. It is on a prominent hill, marked by a standard trig. marker 12' high wood structure. It is accessible by motor vehicle.

RICHMOND PARK: Shoran station was erected at trig. site. It is about 7 miles Southeast of Village Robe, South Australia. It is adjacent to the farm known as "Richmond Park". The farm itself is just North of Millicent-Robe Road. The site is marked by standard trig. marker 12' high structure and it is accessible by motor vehicle.

CORTINA: Shoran station was erected at trig. site. It is located about 35 miles north of Kingston, South Australia, and about 1 mile east of Princess Highway. It is adjacent to a farm known as "Cortina". It is on a prominent hill and marked with a standard 12' high trig. marker structure. It is accessible by motor vehicle.

ROUND HILL: Shoran station was erected on trig. site. It is about 70 miles North Northwest of Kingston, South Australia, and about 1/2 mile east of Princess Highway. It is adjacent to a settlement known as "Magrath Flat". It is on a prominent hill and marked with a standard 12' high trig. marker structure.

It is accessible by motor vehicle.

MOUNT SABINE: Shoran station was erected on trig. site. It is about 8 miles south of Village Forrest, Victoria, and on Forrest-Apollo Bay Road. It is about 1 mile east of this road. It is located halfway between Barramunga and Tambryn Junction on this road. It is adjacent to a Forestry Commission lookout tower. It is accessible by motor vehicle.

MOUNT KILLIECRANKIE: Shoran station was erected on trig. site. It is located on northeasterly part of Flinders Island, Tasmania. It is about 4 miles west of Main Island road which leads from Whitemark North towards Bligh Point. It is accessible by a trail up to a point just about 300' short of the top of the mountain. This 300' must be man-handled over an almost vertical cliff with a rope - contact in Whitemark: Mr. Bowman, General Merchants and Transporters.

ASBESTOS: Shoran station was erected on trig. site. It is located about 7 miles northwest of Beaconsfield, Tasmania. It is on a prominent mountain and marked with a standard 12' trig. marker structure. It is about 1 mile west of Beaconsfield-Badger Head Road. It is accessible from this road by a trail leading to an abandoned lumber camp for about 1/2 mile. This lumber camp is about 4 miles northwest from intersection between Beaconsfield-Badger Head Road and Beaconsfield-Kelso Road. It is accessible by motor vehicle from lumber camp over a recently cleared track to a point just about 200' short of the top of the mountain. This last 200' must be man-handled or tractor-handled.

5. PERSONNEL:

Karel Kovacic	Supervisor
Rex Wollen	* Recording Boat Indicator
Hans Karlsson	* Recording Boat Indicator
Paul Gustafson	Shooting Boat Indicator
Willie Watson	Base station operator
Steve Sauder	Base station operator
Norman Hoffman	Base station operator

*Note: Hans Karlsson replaced Rex Wollen on March 9, 1963.

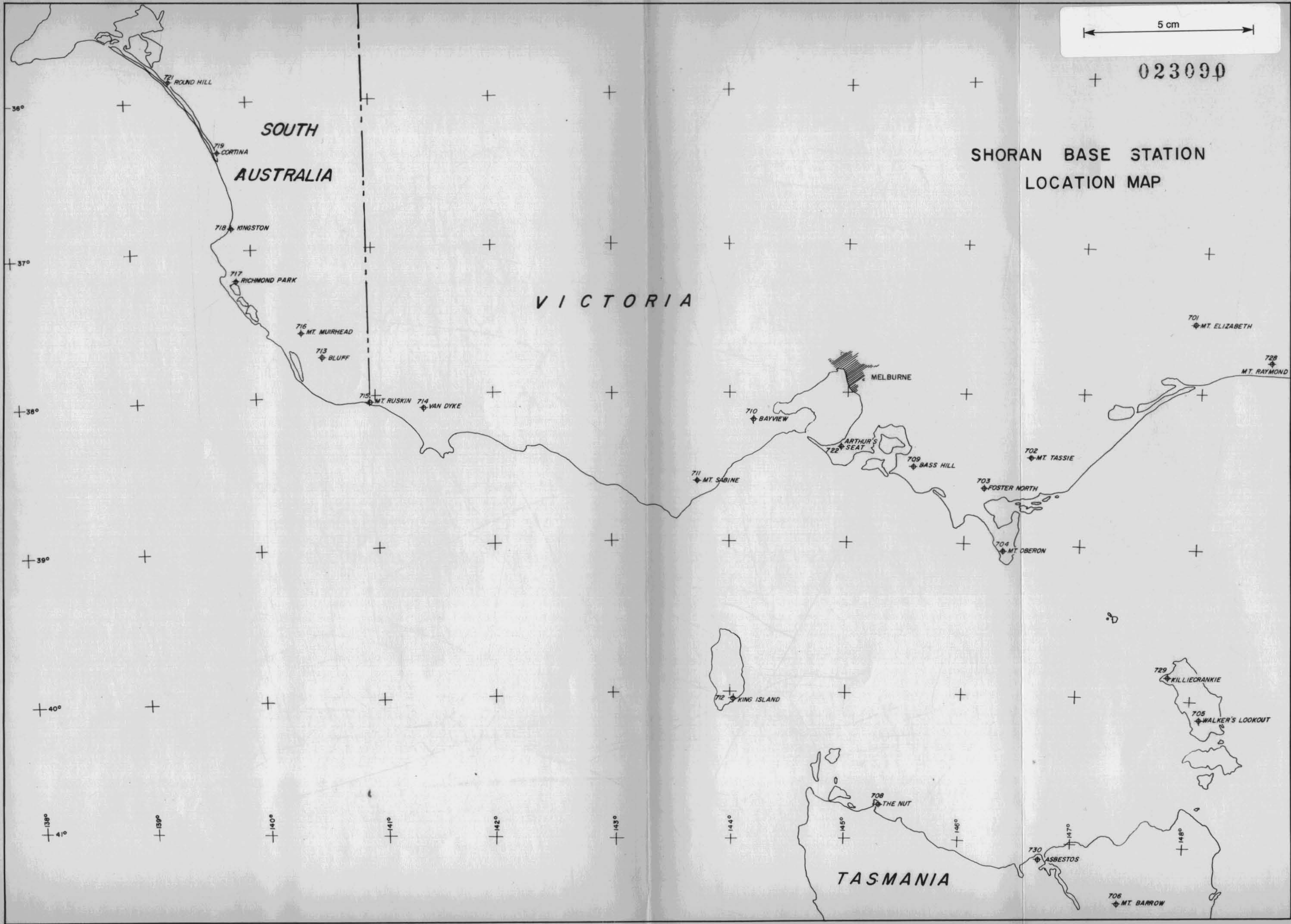
Station No.	Name	Elv.	Geo. Coordinates		Grid. Coordinates		Zone	Period Completed
701	Mt. Elizabeth	3, 085' L	Lat. Long.	37°29'27. 199" 147°55'55. 408"	E 586, 877. 50 N 374, 498. 06	yds. yds.	7	Nov. 10, 62-Jan. 5, 63 Mar. 28, 63-Apr. 7, 63
702	Mt. Tassie	2, 453'	Lat. Long.	38°24'00. 573" 146°33'51. 548"	E 453, 912. 6 N 265, 879. 10	yds. yds.	7	Nov. 11, 62-Jan. 5, 63 Mar. 27, 63-Apr. 7, 63
703	Foster North	1, 036'	Lat. Long.	38°37'22. 781" 146°10'13. 627"	E 416, 234. 1 N 238, 977. 3	yds. yds.	7	Nov. 11, 62-Dec. 27, 62
728	Mt. Raymond	975'	Lat. Long.	37°42'48. 852" 148°36'01. 791"	E 650, 793. 1 N 345, 904. 6	yds. yds	7	Mar. 28, 63-Apr. 7, 63
704	Mt. Oberon	1, 845'	Lat. Long.	39°02'31. 72" 146°20'43. 17"	E 432, 697 N 1, 188. 044	yds. yds.	7	Jan. 7, 63-Jan. 31, 63 Apr. 10, 63-May 10, 63
705	Walkers Lookout	1, 347'	Lat. Long.	40°03'28. 836" 148°04'52. 434"	E 594, 214. 88 N 1, 062, 489. 65	yds. yds.	7	Jan. 4, 63-Jan. 19, 63
706	Mt. Barrow	4, 550'	Lat. Long.	41°22'44. 496" 147°25'17. 150"	E 530, 044. 3 N 903, 264. 2	yds. yds.	7	Jan. 10, 63-Feb. 7, 63
708	The Nut	460'	Lat. Long.	40°45'51. 528" 145°18'15. 894"	E 335, 767. 2 N 978, 734. 0	yds. yds.	7	Jan. 21; 63-Feb. 7, 63 May 9, 63-May 10, 63

Station No.	Name	Elv.	Geo. Coordinates	Grid Coordinates	Zone	Period Completed
712	King Isle.	700'	Lat. 40°02'10.319" Long. 144°01'05.494"	E 215,044.9 yds. N 1,065,350 yds.	7	Feb. 1, 63-Feb. 7, 63
709	Bass Hill	939'	Lat. 38°29'04.14" Long. 145°32'44.1"	E 356,638 yds. N 1,255,701 yds.	7	Mar. 6, 63-Mar. 8, 63 Apr. 9, 63-May 4, 63
710	Bay View	695'	Lat. 38°09'44.06" Long. 144°12'08.68"	E 227,698 yds. N 1,293,255 yds.	7	Mar. 4, 63-Mar. 7, 63
722	Arthur's Seat	930'	Lat. 38°21'21.685" Long. 144 56'56.081"	E 299,521.6 yds. N 1,270,829.9 yds.	7	Mar. 3, 63-Mar. 8, 63
718	Kingston	62'	No Coordinates availble	E 289,123.45 yds. N 455,400.40 yds.	6	Feb. 20, 63-Feb. 25, 63
713	Bluff	658'	Lat. 37°43'39.494" Long. 140°34'19.540"	E 358,743.9 yds. N 347,585.7 yds.	6	Feb. 13, 63-Feb. 19, 63 Mar. 16, 63-Mar. 22, 63
714	Vandyke	600'	Lat. 38°03'59.819" Long. 141°24'59.883"	E 439,985.6 yds. N 306,443.6 yds.	6	Feb. 13, 63-Feb. 18, 63 Mar. 21, 63-Mar. 23, 63
715	Ruskin	110'	Lat. 38° 02'55.2" Long. 140°57'57.2"	E 396,725.6 yds. N 308,710.6 yds.	6	Feb. 12, 63-Feb. 19, 63 Mar. 21, 63-Mar. 23, 63

023089

Station No.	Name	Elv.	Geo. Coordinates		Grid Coordinates		Zone	Period Completed
716	Muirhead	492'	Lat. Long.	37°33'37.097" 140°24'17.587"	E 342, 493. 6 N 367, 808. 6	yds. yds.	6	Feb. 19, 63-Feb. 22, 63
717	Richmond Park	212'	Lat. Long.	37°11'21.340" 139°52'51.054"	E 291, 320. 2 N 412, 383. 9	yds. yds.	6	Feb. 18, 63-Feb. 22, 63
719	Cortina	181'	Lat. Long.	36°19'28.68" 139°46'44.68"	E 280, 096. 6 N 517, 200. 3	yds. yds.	6	Feb. 22, 63-Feb. 25, 63
721	Round Hill	120'	Lat. Long.	35°49'37.510" 139°23'07.922"	E 240, 445. 5 N 577, 016. 8	yds. yds.	6	Feb. 23, 63-Feb. 25, 63
711	Sabine	1,914'	Lat. Long.	38°37'33.108" 143°43'49.849"	E 660, 069. 38 N 234, 774. 16	yds. yds.	6	Mar. 24, 63-Mar. 25, 63 Apr. 11, 63-Apr. 16, 63
729	Killie-crankie	1,047'	Lat. Long.	39°48'47.588" 147°51'42.340"	E 574, 353. 36 N 1, 092, 670. 56	yds. yds.	7	Apr. 26, 63-May 7, 63
730	Asbestos	1,289'	No Coordinates available		E 463, 823. 62 N 933, 745. 91	yds. yds.	7	May 6, 63-May 10, 63

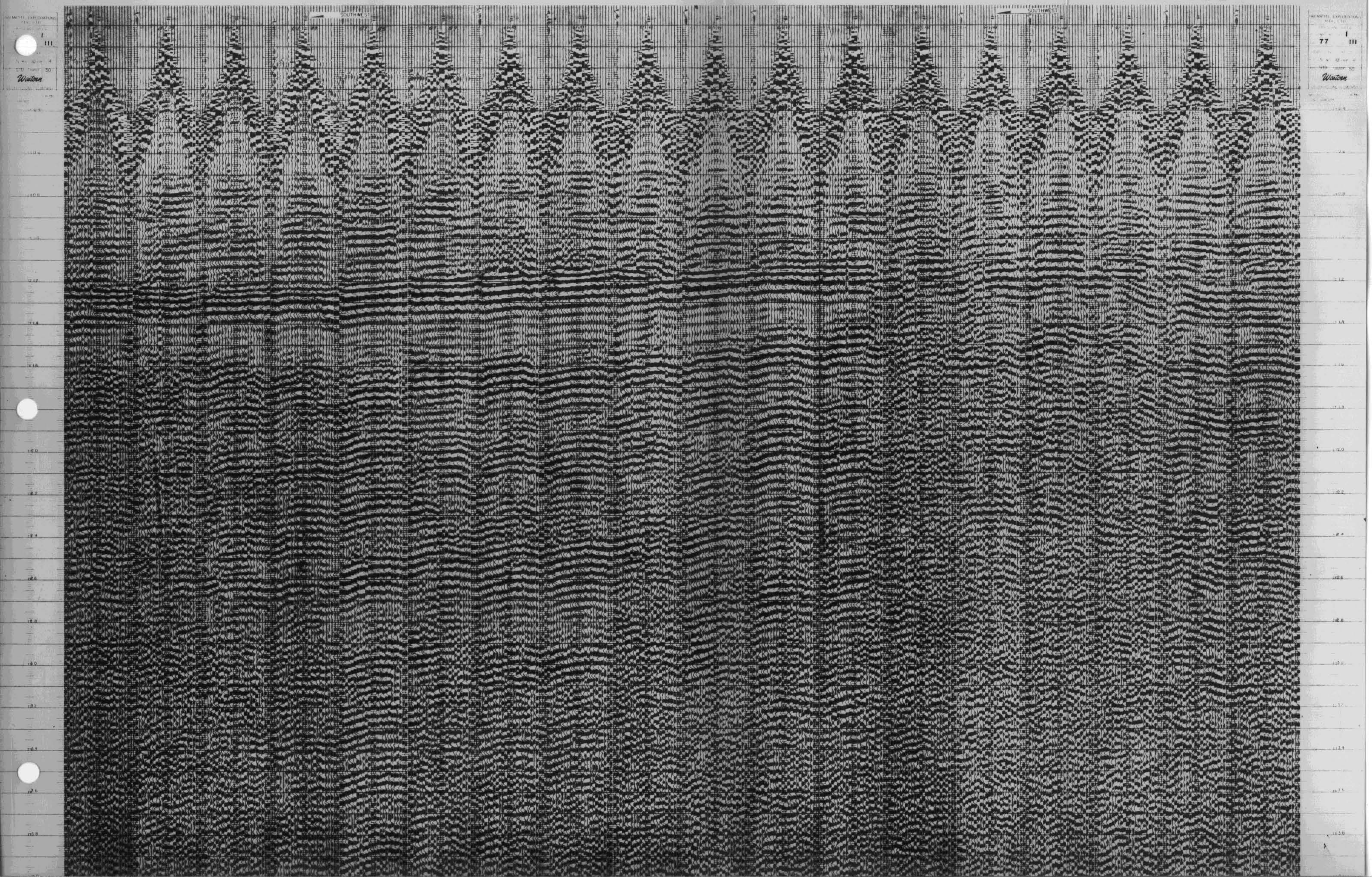
PLATE I-A


5 cm
023090
SHORAN BASE STATION
LOCATION MAP
SOUTH
AUSTRALIA
VICTORIA
TASMANIA
MELBURNE
721 ROUND HILL
719 CORTINA
718 KINGSTON
717 RICHMOND PARK
716 MT. MUIRHEAD
713 BLUFF
715 MT. RUSKIN
714 VAN DYKE
710 BAYVIEW
722 ARTHUR'S SEAT
709 BASS HILL
711 MT. SABINE
702 MT. TASSIE
703 FOSTER NORTH
704 MT. OBERON
701 MT. ELIZABETH
728 MT. RAYMOND
712 KING ISLAND
729 KILLIECRANKIE
705 WALKER'S LOOKOUT
708 THE NUT
730 ASBESTOS
706 MT. BARROW
36°
37°
38°
39°
40°
41°
138°
139°
140°
141°
142°
143°
144°
145°
146°
147°
148°

5 cm

GIPPSLAND AREA

023091

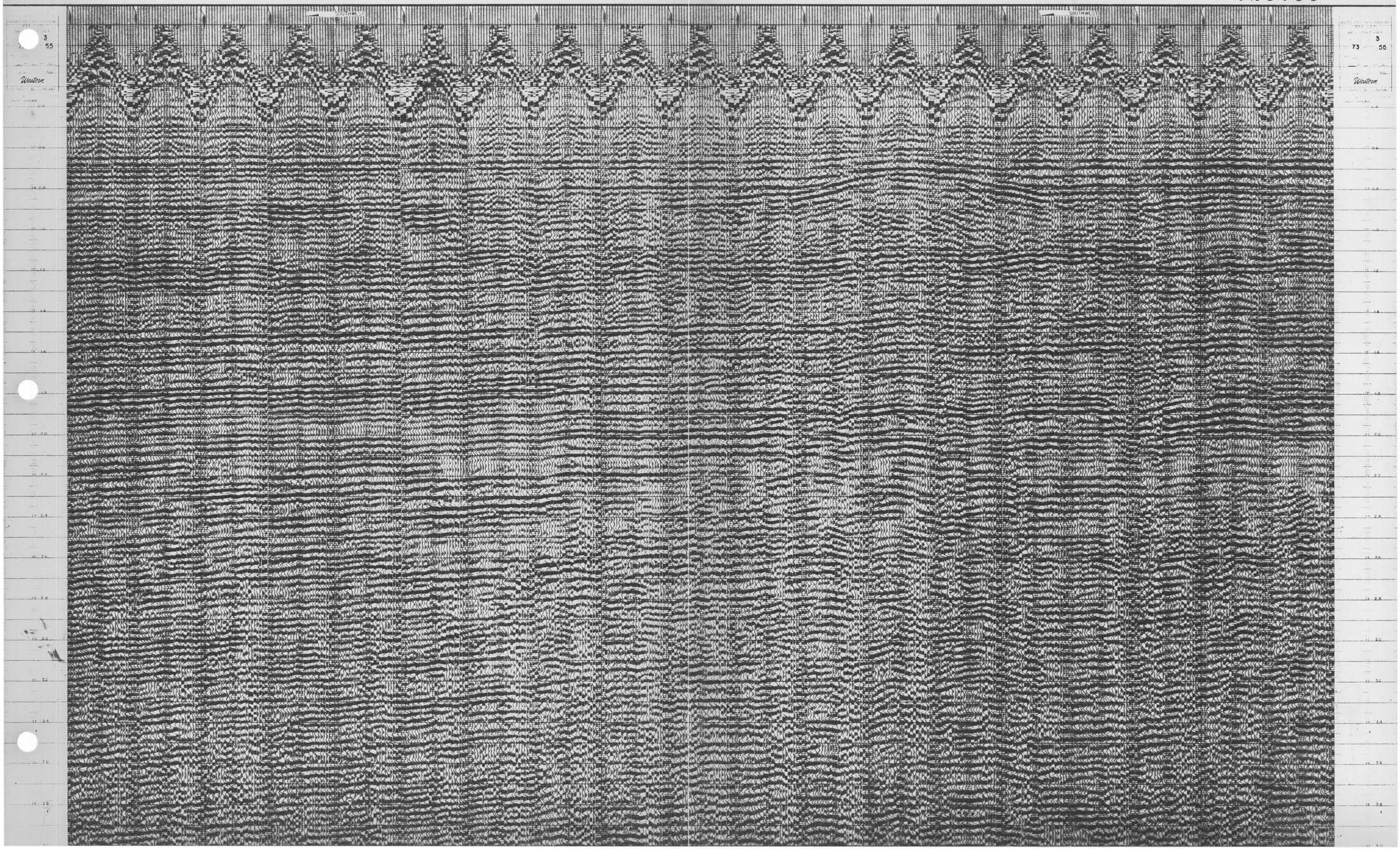


5 cm

GIPPSLAND AREA

023092

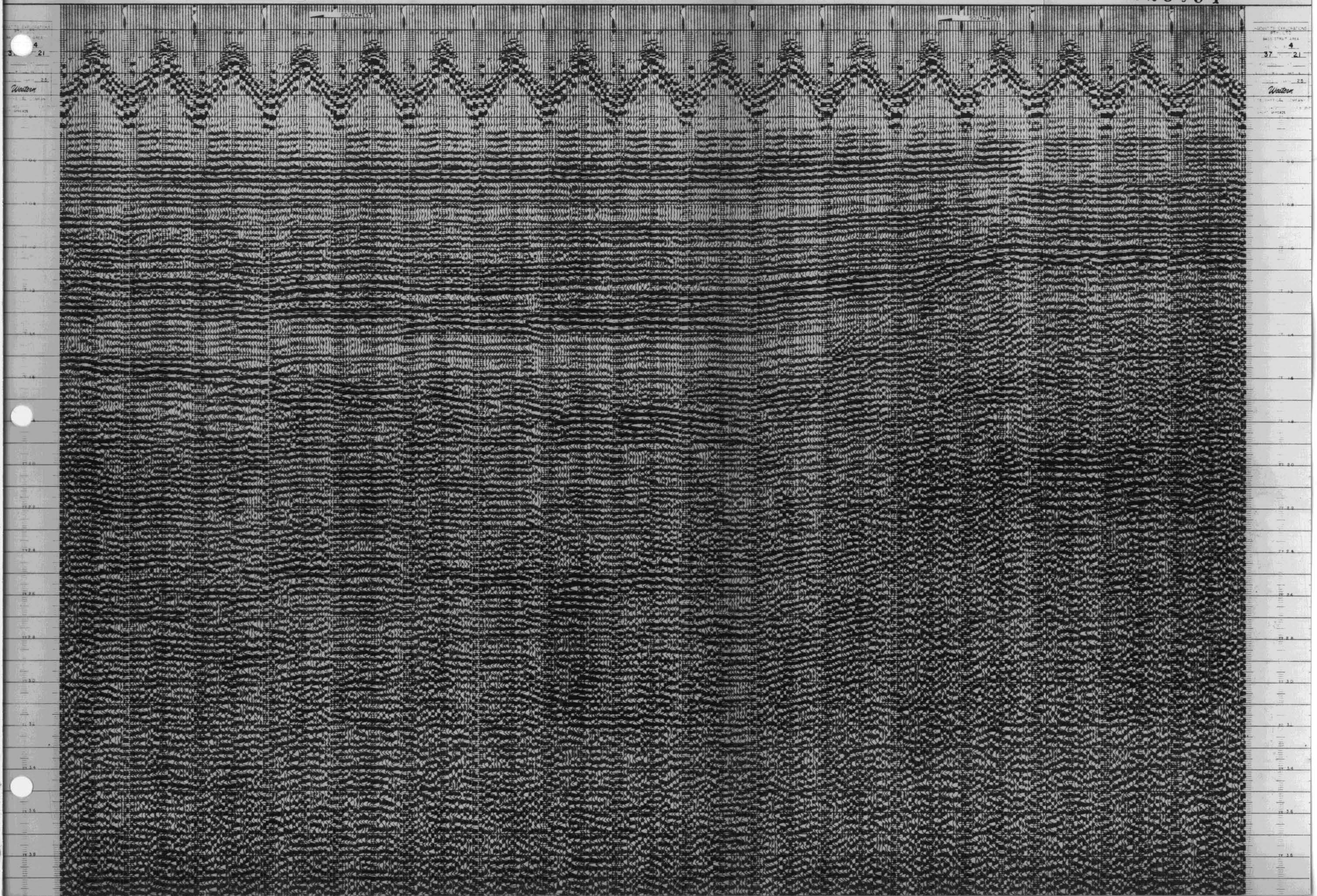
BASS STRAIT AREA
023093



5 cm

BASS STRAIT AREA

023094



5 cm

023095

BASS STRAIT AREA


5 cm
023096
SOUTH AUSTRALIA AREA

5 cm

SOUTH AUSTRALIA AREA

023097