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EPP 13

POLDA BASIN

POLDA BASIN FIRST MARINE SEISMIC SURVEY FINAL REPORT

Submitted by

Bridge Oil N/L
1970

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1ST OFFSHORE POLDA BASIN MARINE SEISMIC SURVEY

E.P.P.-13 SOUTH AUSTRALIA

for

BRIDGE OIL N.L.

TELEDYNE EXPLORATION INTERNATIONAL INC.

36 - 38 Clarence Street,

Sydney, New South Wales.

and

AUSTRALIAN EXPLORATION CONSULTANTS PTY. LTD.

283 Alfred Street North,

North Sydney, New South Wales.

July, 1970.

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ABSTRACT

A marine seismic survey was conducted in E.P.P. 13, South Australia during February, 1970 for Bridge Oil N.L.

The survey was designed to investigate the offshore continuation of the Polda Basin and primarily consisted of 24-fold continuous reflection profiling using an air-gun source. Some single channel sparker profiles and sonobuoy refraction data were also obtained.

The reflection data were good, although highly complicated due to numerous diffractions, multiple reflections and unconformities.

The survey delineated a graben structure in which sedimentary thickness reaches at least 14,500 feet.

Structures suitable for entrapment of hydrocarbons were indicated but not sufficiently well delineated to locate drilling sites.

INTRODUCTION

The operations of the Marine Seismic Survey for Bridge Oil N.L. were commenced by Teledyne Exploration International on 6th February, 1970 and completed on the 17th of the same month.

Australian Exploration Consultants Pty. Ltd. was contracted by Bridge Oil N.L. to supervise the operations and interpretation of the survey.

The survey was conducted on E.P.P. S.A. 13 in the Great Australian Bight, west of Venus Bay, South Australia. Plate 1 outlines the blocks contained in this concession.

The area was initially surveyed using fathometer and Teledyne's 160,000 Joule Super Sparker System on an approximate 10 mile grid. A field interpretation of these data was made and the original program modified to conduct the common depth point, air-gun survey over features of major interest.

The field effort furnished 231.3 miles of single-channel sparker profiles, 323.8 miles of 24-fold continuous reflection profile recordings, and two refraction profiles using sonobuoys.

A full description is contained in an operations report which was submitted to the Bureau of Mineral Resources in June 1970. A copy is attached hereto as Appendix A.

Parameters and programs used in the digital data processing are attached as Appendix B.

OBJECTIVES OF THE SURVEY

The general objective of the survey was to provide structural and stratigraphic control in the offshore part of the Polda Basin.

In particular, the following information was sought:-

(i) Distribution, thickness and configuration of the sediments in the Polda Basin.

(ii) Definition of the limits of the Elliston Trough within E.P.P. 13.

(iii) Any other information contributing to an understanding of basin history and structure.

REGIONAL GEOLOGY & PREVIOUS GEOPHYSICS

The most recent discussion of the regional geology and previous geophysics applicable to the survey area is by Smith and Kamerling (Reference 1).

Aeromagnetic surveys (Reference 2) suggested the presence of a narrow sedimentary trough running east-west across the Continental Shelf from Venus Bay on Eyre Peninsula. Smith and Kamerling refer to this structure as the Elliston Trough. The South Australian Geological Survey considers this structure a feature within the Polda Basin.

Onshore, the Basin is known to contain sequences of Tertiary and Jurassic sediments (Reference 3). Interpretation of aeromagnetic data indicated that more than 8,000 feet of sediments might be present in parts of the offshore extension of the Basin. Reconnaissance seismic data (Reference 4 & 5) supported this interpretation but were sparse and generally poor in quality.

The general geological history of South Australia suggests that deposition in the area of the Polda Basin could have occurred during Proterzoic, Lower Paleozoic, Upper Paleozoic, Mesozoic and Cainozoic times.

Major regional unconformities are known in South Australia between Proterozoic and Cambrian; between Lower and Upper Paleozoic; and at the base of the Mesozoic. Other unconformities are known in the Mesozoic and the Tertiary. (Reference 6 & 9).

RESULTS OF THE SURVEY

The survey results are presented as corrected variable area - wiggle trace record sections at a horizontal scale of 1200 feet to the inch and a vertical scale of 1 second to 5 inches. In addition time-maps have been compiled on two reflection events, Horizons A and B (Plates 7 and 8). A bathymetric map has been prepared as shown on Plate 6.

Although considerably improved in quality relative to earlier surveys in adjacent areas, the data obtained are highly complex. The complexity is due to:-

(i) the presence of at least three unconformities in the reflecting section - these occur, respectively, beneath a thin, shallow, flat-lying sequence; below Horizon A; and below Horizon B;

(ii) widespread diffracted energy arising from the major, graben-boundary, faults, numerous smaller adjustment faults, and the occasionally, steeply-dipping erosional surface of Horizon A;

(iii) strong multiple reflections occurring at a number of levels.

The diffractions and multiple reflections remain present despite extensive data enhancement, and particularly interfere with the deeper, primary reflection energy. Deep structure can be reliably mapped from the data in their present form only in the restricted area covered by the Horizon B map. However, it is considered that valid primary reflections, although not correlatable, occur in places to considerable depth, e.g., Line 1, S.P. 601-633.

/continued

RESULTS OF THE SURVEY

The following major features are evident on the record sections:

(a) a narrow graben bounded by major faults striking approximately east-west;

(b) a considerable thickness of folded and/or draped sediments within the graben;

(c) a thin veneer of horizontal beds throughout the area of the survey.

Details of the refraction studies made on Lines 1 and 13 are given in Appendix C attached to this report. Generalized results are:-

Location (Line & Shot Point)	Depth Below Sea Level (Feet)	Average Refractor Velocity (Feet/sec.)	Approx. Dip
1-595	300	6400	1°
	2100	3350	1°
13-630	400	7300	6° West
	5700	12000	4° West

The velocities recorded at the deeper refractors are suggestive of sedimentary rocks. At 1-595 the 3350 ft./sec. velocity may be identified with a reflection at about 0.720 seconds, several cycles shallower than the reflection contoured as Horizon A. At 13-630 the deeper refractor is not identified with any reflection visible on the cross-section. This may, in this case, be due to proximity to a large fault that cuts out all deep reflections. It is possible that the refraction path here does not lie in a vertical plane below the surface spread, thus violating a basic assumption of refraction analysis, and perhaps invalidating the observed depth and velocity.

INTERPRETATION

The Elliston Trough is shown by the data to be a down-faulted block (graben) with controlling major faults on its southern and northern limits, F-1 and F-2 respectively. Sediments within the graben thicken to the west from a relative stable area adjacent to the western coast line of the Eyre Peninsula. The graben continues westward beyond the limits of the survey.

Horizontal beds occur immediately beneath the sea bed throughout the area surveyed. Very strong, good quality reflections are recorded from this sequence. An angular unconformity at about 100 milliseconds below the sea bed can be identified on Line 13 S.P. 100-148. This unconformity is believed to be present at this level on all lines but is generally masked by strong multiple reflections. The horizontal sequence is believed to be of Pliocene to Recent age.

Horizon A has been mapped over the majority of the survey area, within a time range of .400 seconds to 1.250 seconds. It lies above a very irregular erosional surface which itself cannot be adequately identified for mapping. However, Horizon A indicates the remnant erosional highs and lows at this unconformity. Several adjustment faults are mapped at this level.

The average velocity to Horizon A obtained from the AUTOVEL* velocity analysis is approximately 7000 feet/sec. Velocity analysis indicates an inversion associated with this horizon.

On the basis of this type velocity information and the velocities obtained from the refraction profiles as described above, Horizon A may be of Oligocene age.

* Teledyne Trademark

continued INTERPRETATION

Seve... of highs have been mapped on Horizon A. However, as altern... ...ing is possible, additional data would be necessary ... closure.

Horizon B is based on good reflection arrivals in the center port on of the trough, within the time range of 0.700 seconds to 2.150 seconds. It shows gentle dip and is faulted out on the southern boundary fault, F-1. The horizon is probably present throughout the remainder of the graben but cannot be correlated because of interference from diffractions and multiple reflections.

The average velocity to this event on Line 1, shot point 609, is approximately 11,000 feet/sec. indicating a depth of approximately 9,700 feet. From consideration of the velocities, and location within the reflecting section, it is believed that Horizon B is of Lower Paleozoic age.

There are no continuous mappable events between Horizon B and the unconformity below Horizon A, but contrasting dip segments suggest that there may be another unconformity within this interval.

A reflecting sequence considerably deeper than Horizon B is shown in the data, particularly on Line 1 between shot points 601 and 697. The sequence is truncated by beds conformable with Horizon B.

At shot point 601 on Line 1 this sequence is present to a depth of at least 14,500 feet. Sediments may continue to considerably greater depths.

/continued

INTERPRETATION

Possible deep structures are indicated in the data west of the area mapped. Intermittent events possibly correlatable with Horizon B or deeper reflections were recorded, but lack of continuity and numerous diffractions and multiples make definite correlations impossible.

RECOMMENDATIONS

To resolve primary events from diffractions and multiples it is recommended that further enhancement of existing data by time migration and dip separation should be attempted. If successful, a review of the interpretation should be made.

Subject to this review it is probable that additional seismic work will be necessary before drilling locations can be determined.

Respectfully submitted,

AUST. EXPL. CONSULTANTS PTY.LTD.

K. R. Seedsman
Geophysicist

TELEDYNE EXPLORATION CO.

D. R. Bealer
Manager - Far East

CONCLUSIONS

The limits of the Elliston Trough within the surveyed area have been defined. The reflection section and velocity information indicate that at least 14,000 feet of sediments are present in portions of the Trough. However, the data in the present form are not adequate to determine in detail the distribution and configuration of the sediments within the graben. Structures capable of trapping hydrocarbons are probably present due to combination of faulting, filling and draping, but have not been sufficiently delineated to permit or justify test drilling at this stage.

ACKNOWLEDGEMENTS

The authors express their appreciation to Mr. A. Kapel, Bridge Oil N.L. and Mr. L. Ingall of Australian Exploration Consultants Pty. Ltd. for assistance and co-operation throughout this project.

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APPENDIX A

OPERATIONS REPORT

TO

BRIDGE OIL N.L.

SUBMITTED BY

TELEDYNE EXPLORATION INTERNATIONAL INC.

D. R. BEALER - MANAGER

F. D. BOWMAN - SUPERVISOR

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ABSTRACT

A marine seismic survey was conducted by Teledyne Exploration International Party 708 – for Bridge Oil N.L. from 6 February, 1970 to 17 February, 1970 in the Great Australian Bight area offshore South Australia. Predetermined shotpoint positions were IBM computed.

Navigation was by Offshore Navigation Inc. of New Orleans. Louisiana under contract to Teledyne Exploration International. The shipboard navigation equipment and the shore stations were operated by ONI personnel.

Logs were maintained on all instrument settings, streamer depths, water depths, ship positions and shotpoint and streamer locations.

Operation headquarters were maintained in Sydney, N.S.W. Australia. The vessel operated out of Port Lincoln and Venus Bay, South Australia.

The seismic program, survey method, instrumentation operating techniques and operational results are presented in this report.

SECTION 1.

AREA OF SURVEY.

A. SEISMIC PROGRAM.

The seismic program was located in the Great Australian Bight area offshore South Australia. Lines were shot for twenty-four-fold common depth point (CDP) coverage. Shotpoints were numbered consecutively and spaced at 300 foot intervals.

B. PHYSICAL CONDITIONS.

The survey was located within the limits of EPP-13.

The water depth averaged 210 feet and remained fairly constant through-out the prospect. The weather conditions ranged from good through heavy seas.

SECTION II

NAVIGATION

Navigation was by Offshore Navigation Inc. of New Orleans, Louisiana under contract to Teledyne Exploration International. Mr. John Montague was the ONI party chief and maintained his operations headquarters at Port Lincoln, South Australia. Two base stations were set up to horizontally control the vessel's position throughout the entire program.

Step–back for post–plotting was computed to be at 580 feet.

SECTION III

SYSTEMS

A. RECORDING SYSTEM.

One 24 trace SDS 1010 Binary Gain Ranging Digital Recording System (9track, ½ inch tape) was used to record the data. The master control panel had pre–data constants used for day, month and line number. Four second records were taken with a 4 ms sampling rate, while release rate was set at "Medium" and trip sensitivity varied from –18 to –30 db. The early gain was staggered from approximately 60 db. for trace No. 24 to 20 db. for trace No. 1. On the binary gain amplifier filters were set at 75 HZ on the high side to 10 HZ on the low side with the Alias filter set at "Low". The playback amplifiers were set with no AGC, 75 HZ on the high side and 15 HZ on the low side.

A facsimile recorder, Model No. 24255, modified Raytheon PFR–193 was used for a section monitor.

B. SOURCE.

Two 300 cu. in. and one 120 cu. in. Bolt Model 1500 B air guns were used as a a sound source. These guns were towed 100 feet astern of the vessel at a depth of 30 feet, fired at 12–13 second intervals and operated at 2000 PSI.

SECTION IV

STREAMER

The neutrally-buoyant Paisley streamer employed throughout the prospect has 24 equally spaced 200 foot long line sections. Each line has 20 crystal detectors spaced at 10 foot intervals the outputs of which yield one trace.

There were two stretch sections preceding group 24. The stretch sections contained nylon stress members to attenuate noise generated by the towing vessel. One stretch section followed the last line section (Group 1) and a tail buoy was attached to the end of the streamer by a nylon rope

The streamer was ballasted to ride horizontally below wave action. A variable length of polyethylene covered lead-in cable connected the streamer to the towing vessel. Under continuous tow, the streamer became hydrodynamically stable at a depth which is a function of its speed through the water, the length of the lead-in cable and the relative buoyancy along the streamer's length.

Four Seismic Engineering Company Model DI-104B depth indicators and Model DT-103 depth transducers were used along with Condeps to control cable depth Readings were taken from meters in the instrument room. Average streamer depth was 50 feet.

SECTION V.

OPERATIONS :

A. TELEDYNE CREW.

F. Don Bowman	–	Supervisor
W. B. Springer	–	Party Chief
Sheldon De Trafford	–	Digital Technician
Roby Surle	–	Observer
Marc Sol	–	Observer
Colin Green	–	Air Gun Mech.
Don Waugh	–	,, ,, ,,
Max Summers	–	,, ,, ,,

B. VESSEL AND CREW.

The M/V Teledex IV, a 134' x 27' x 8' draft, with ships crew was used as a survey vessel. The vessel is equipped with the following: recording fathometer, Raytheon marine telephone, SSB radio, two 100 KW generators, freezers and coolers and air–conditioned sleeping and messing accommodations for 20 people and has a cruising speed of 11 knots. The ships crew was as follows:

Howard King	–	Captain
Noel Bertrand	–	Mate
Lew Burley	–	Engineer
Ralph Caruna	–	Cook
Ray Lugg	–	Deck Hand
Ernie Fabian	–	Messman

SECTION VI

OPERATIONS SUMMARY

The Teledex IV left Port Lincoln, South Australia on 6 February, 1970 for the prospect area. The [illegible] system was checked out while enroute.

Mr. Adrian Kapel of Bridge Oil N.L. and Mr. Lindsay Ingall of Australian Exploration Consultants Pty. Ltd. joined the vessel at Port Lincoln to observe operations aboard.

The Teledex IV commenced operations on 7 February, 1970 with Line I being the first line shot. After completing lines 1, 2 and 4 it was decided the remaining line locations needed to be changed to cover the area of interest. Co-ordinates of the newly located lines were sent to Sydney where IBM computed pre-plots were made. The vessel pulled into Venus Bay, South Australia on 10 February, 1970 to receive the pre-plots and to work on the Paisley cable. Mr. Kapel left the vessel at Venus Bay. The vessel returned to the prospect area on 11 February and all CDP seismic work was completed on 15 February, 1970.

The vessel returned to Venus Bay to pick up Mr. Brian Plummer of the University of N.S.W. to help with the sona buoy refraction survey. The vessel left Venus Bay on 16 February 1970 to commence the refraction work. The refraction work was started on 16 February, 1970 and completed on 17 February, 1970. The Teledex IV arrived at Port Lincoln on 18 February, 1970.

A total of twelve lines were completed using the SDS 1010 digital system and Paisley cable. The program covered 323.8 statute miles and took 56.3 shooting hours to complete. A total of [illegible]15 digital Memorex tapes were used.

Respectfully submitted,

TELEDYNE EXPLORATION INTERNATIONAL INC.

D. R. Bealer

Manager – Far East.

APPENDIX B

REDUCTION OF DATA

The magnetic tapes and relevant logs, flow sheets, etc. were sent to Teledyne's Houston Digital Data Processing Center for reduction which consisted of the following procedures airgun, reflection data:-

(a) EDITING

The data were edited for recorded irregularities, corrected for data skew diagnostic messages, were printed out and an edited gapped multiplexed tape was produced. The printed information consists of shot point numbers, length of data, time break and water break times, results of tape error analysis (if any), and instrument parameters recorded on the field tape.

(b) DEMULTIPLEXING

The demultiplex program read the output of the edit programs, demultiplexed the data into trace format, performed binary gain ranging recovery, applied spherical spreading compensation or data dependent amplitude recovery, attached data information to the trade headers, and wrote sequential trace records on tape. The output reel of the demultiplex program was written in the SEG exchange tape format.

(c) AUTOCORRELATION SECTIONS AND SPECTRAL ANALYSIS

Utilized for the purpose of studying multiplies and frequency content of the seismic data for designing deconvolution operators and digital filters. Studies were run every five miles.

(d) VELOCITY ANALYSIS - AUTOVEL*

Operation involved automatically determining RMS velocities from the common depth point ensembles. Multiple cross correlation techniques were utilized which result in optimum coherence of reflected energy. This program permitted several options such as any number of uniform time windows and window widths, deconvolution, filtering, and variable velocity ranges. The output was a plotted and printed display of RMS velocities versus two-way time. Velocity analysis was run every five miles.

(e) CONTINUOUS PROFILES (100%)

Continuous profiles (deconvolved and band pass filtering) were run for velocity monitoring. The continuous profiles without deconvolution were run to check residual velocity corrections. A film plot was provided.

(f) STACKING

The proper dynamic corrections as determined by AUTOVEL* and/or 100% continuous profile were applied. Velocity function changes were made on shot point boundaries and were changed as frequently as deemed necessary. Any necessary trace weighting, muting, surgical blanking, trace omission, and polarity reversal was applied and the data was then stacked. A plotted film and an ozalid print were provided. The tape generated is in the SEG exchange tape format.

* Teledyne Trademark

(g) TIME VARIANT DECONVOLUTION AND DIGITAL FILTERING AFTER STACK

A maximum time variant deconvolution operator (based on water depth) was designed in the time domain and was optimized in the least squares sense. Digital filtering was provided. A filtered final section display was provided with one ozalid print.

(h) PRESENTATION

The final section was variable area wiggle trace with a five inch per second vertical scale and horizontal scale of one inch per 1200 feet.

(i) NOTATIONS

Each section has a heading showing all parameters used in processing. Line intersections and velocity control prints as marked along the top of the section. Shot points and water depths are marked above respective positions.

The water depths registered on the sections, above the shot point number, are incorporated in the bathymetric map.

The base map was prepared by Offshore Navigation Inc. of New Orleans, Louisiana, U.S.A.

APPENDIX C

DATA REDUCTION

AND INTERPRETATION

BRIDGE OIL N.L

REFRACTION LINES 1 & 13

Facsimile records made aboard the M/V Teledex IV on 16 and 17 February, 1970 were used, together with Shoran position postplots, to compute the air gun - sonobuoy refraction data. The records and maps (2 sets, 1 interpreted) and computation are transmitted herewith.

The computation procedure was composed of six steps:

(1) Horizontal Scaling of Maps and Records

Shoran post plot maps were scaled to find the nominal offset distances between shot points used for timing of seismic event travel times. These positions were noted by red lines on the interpreted records.

(2) Identification and Timing of First Arrivals

Red lines were drawn on the facsimile record identifying the first arrival alignments for the direct water path and refraction events A (near water bottom) and B.

(3) Computation of Offset by use of Water Path Data

A water velocity of 1465 meters per second was used to compute true offset positions of the timing shot points from the sonobuoy, using the formula S = VT.

(4) Computation of Offset Corrections

In order to check on the reasonableness of the offsets found, plots were made of total offset correction, C, against the direct wave travel time, W. The intercept of the curve or line connecting such plots on the W=O axis gives the bias correction, B. This is the horizontal distance between the reference shot point and the point at which the sonobuoy and air gun passed each other after sonobuoy launch. The slope of the plotted curves, expressed in meters per second, when divided by water velocity, gives the buoy drift component as a percentage, P, of vessel offset, O.

The sum C=B+PO gives the total offset correction applicable at each vessel offset. All data indicate a buoy drift component to the West. The drift rates vary between 1.71% and - 34.40% of vessel speed.

(5) Computation of Refraction Velocities

Using the offsets derived from the direct water path arrivals, the apparent horizontal velocities of events A and B were computed from their first arrival times as follows:

Line No.	Event	East (M/Sec.)	West (M/Sec.)	Average (M/Sec.)
1	A	1900	2000	1950
	B	2462	2617	2540
13	A	2481	1978	2230
	B	3872	3418	3645

(6) Computation of Refractor Depths

Average depths to refractors A and B were computed by use of intercept times and a two layer velocity structure, the water layer being the upper one. Depths below sea surface and dips computed were as follows:

Line No.	Event	Average Depth (M)	Average Dip Component
1	A	91	Less than 1°
	B	725	Less than 1°
13	A	121	Approx. 6° West
	B	1866	Approx. 4° West

Interpretation

On Line 1 refractor A occurs 20 meters below the sea floor, probably due to low velocity covering above the solid rock refractor or to a late picking of the first arrivals. On Line 13 the average depth of refractor A computes 56 meters below the sea floor and a substantial Westward dip of the refractor is probable. The lithology of refractor A apparently differs between Lines 1 and 13, with a higher velocity material on the latter.

Refractor B is probably not correlative from Line 1 to Line 13, due to the large difference in observed velocities. At this level substantial Westward dip is again suggested on Line 13.

MATHEMATICAL APPENDIX

BRIDGE OIL N. L.

11 MAY 1970

Line 1 Refraction

1. Event	2. Location	3. Travel Time (Sec.)	4. Nominal Offset (M)	5. Offset by Direct Trav. T. (M) @1465 M/Sec.	6. Total Offset Correction (M) 5-4	Apparent Velocity (M/Sec.)
East Going Vessel						
Direct	X=O	.000	-	0		
	S.P. 560	.203	0	297	297	
	S.P. 570	.856	940	1254	314	
	S.P. 585	1.850	2305	2710	405	
A	X=O	.063	-	0		
	S.P. 560	.218	0	297		$\frac{297}{.218 - .063} = 1,916$
	S.P. 570	.729	940	1254		$\frac{1254}{.729 - .063} = 1,883$
B	X=O	.249	-	0		
	S.P. 560	.367	0	297		$\frac{297}{.367 - .249} = 2,517$
	S.P. 570	.764	0	1254		$\frac{1254}{.764 - .249} = 2,435$

1. Event	2. Location	3. Travel Time (Sec.)	4. Nominal Offset (M)	5. Offset by Direct Trav. T. (M)	6. Total Offset Correction (M)	
				@1465 M/Sec.	5-4	
	S. P. 585	1.362	2305	2710	2710 / 1.362 - .249	= 2,435

West Going Vessel

Direct	X=O	.000	-	0	-	
	S.P.660	.154	0	226	226	
	S.P.645	.882	1370	1292	-78	
	S.P.605	2.849	5030	4174	-856	
					Apparent Velocity (M/Sec.)	
A	X=O	.064	-	0		
	S.P.660	.177	0	226	226 / .177 - .064	= 2,690
	S.P.645	.710	1370	1292	1292 / .710 - .064	= 2,000
B	X=O	.244	-	0		
	S.P.660	.328	0	226	226 / .328 - .244	= 2,690
	S.P.645	.758	1370	1292	1292 / .758 - .244	= 2,514
	S.P.605	1.921	5030	4174	4174 / 1.921 - .244	= 2,647

Line 1 Refraction

Depth Computation

Event A (Probable Sea Floor Refractor)

Average Intercept = .0635 sec.

Average Velocity = 1950 M/sec. = V_1

Average Depth of Water by Fathometer : 71 M
Hydrophone Depth : 18 M
Air Gun Depth : 9 M

Source Depth + Sensor Depth Correction =

$$\frac{+\ 27}{1465} = +.0184 \text{ sec.}$$

Intercept Corrected to Sea Surface = .082 sec.

Average Refractor Depth below sea surface =

$$D = \frac{V_0\ V_1\ t}{2\sqrt{V_1^2 - V_0^2}} = \frac{1465 \cdot 1950 \cdot .082}{2\sqrt{1950^2 - 1465^2}}$$

$$= \frac{2,856,750 \cdot .082}{2\sqrt{3,802,500 - 2,146,225}} = \frac{234,254}{2\sqrt{1,656,275}}$$

$$= \frac{234,254}{2 \cdot 1287.5} = \frac{234,254}{2,575} = 90.97 \text{ M}$$

Event B

V_0 = 1465 M/Sec., V_1 = 1950 M/Sec., Z_0 = 91 M

Average Intercept .2465 sec.

Average Velocity 2540 M/sec. = V_2

Average Intercept Corrected to Sea Surface = .265 = T_{12}

From Nettleton, p. 254

$$Z_1 = (T_{i2} - 2 Z_0 \sqrt{V_2^2 - V_0^2} / V_0 V_2)\ V_1 V_2 / 2\sqrt{V_2^2 - V_1^2}$$

Substituting,

$$Z, = (.265 - 182000 \quad 6.45 - 2.15/3.72 \cdot 10^{6})$$

$$- 4.95 \cdot 10^{6}/2000 \quad 6.45 - 3.80$$

$$= (.265 - .182 \quad 4.30/3.72) \; 2.475 \cdot 10^{3} \quad 2.45$$

$$= (.265 - .0489 \cdot 2.074) \; 2.475 \cdot 10^{3} \cdot 1.565$$

$$= (.265 - .1014) \; 3.873 \cdot 10^{3}$$

$$= .1636 \cdot 3.873 \cdot 10^{3} = 634 \text{ M}$$

Line #3 Refraction

Event	Location	Travel Time (Sec.)	Nominal Offset (M)	Offset by Direct Trav. T. (M) @ 1465 M/Sec.	Total Offset Correction (M) 5 - 4
East Going Vessel					
Direct	X=O	0	-	0	
	S.P. 600	.088	0	129	129
	S.P. 630	2.122	2749	3109	360

Event	Location	Travel Time (Sec.)	Nominal Offset (M)	Offset by Direct Trav. T. (M)	Apparent Velocity (M/Sec.)
A	X=O	.153	-	0	
	S.P. 600	.209	0	129	$\frac{129}{.209 - .153} = 2304$
	S.P. 630	1.406	2749	3109	$\frac{3109}{1.406 - .153} = 2481$

1. Event	2. Location	3. Travel Time (Sec.)	4. Nominal Offset (M)	5. Offset by Direct Trav. T(M) @ 1465 M/Sec.	6. Total Offset Correction(M) 5 - 4
B	X = O	.407	-	0	
	S.P. 600	.440	0	129	$\frac{129}{.440-.407} = 3909$
	S.P. 630	1.210	2749	3109	$\frac{3109}{1.210 - .407} = 3872$

West Going Vessel

1. Event	2. Location	3. Travel Time (Sec.)	4. Nominal Offset (M)	5. Offset by Direct Trav. T(M) @ 1465 M/Sec.	6. Total Offset Correction(M) 5 - 4
Direct	X = O	0	-	0	
	S.P. 660	.102	0	149	149
	S.P. 630	1.782	2743	2611	-132
				Apparent Velocity(M/Sec.)	
A	X = O	.058	-	0	
	S.P. 660	.136	0	149	$\frac{149}{.136 - .058} = 1910$
	S.P. 630	1.378	2743	2611	$\frac{2611}{1.378-.058} = 1978$
B	X = O	.156	-	0	
	S.P. 660	.198	0	149	$\frac{149}{.198-.156} = 3465$
	S.P. 630	.920	2743	2611	$\frac{2611}{.920-.156} = 3418$

X

			Slope Ratio	Approx. Dip
$V_0 = 1465$	M/Sec.			
$V_1 = 2230$	M/Sec.	2230/1978 =	1.13	6^o
$V_2 = 3645$	M/Sec.	3645/3418 =	1.07	4^o

Line 13 Refraction

Depth Computation

Event A (Probable Sea Floor Refraction)

Average Intercept = (.153 + .058) /2 = .1055 sec.

Average Velocity = 2230 M/sec.

Average Depth of Water by Fathometer : 55 M (? 60 M)

Hydrophone Depth : 9 M

Source Depth + Sensor Depth Correction =

$$\frac{27 \; (18?)}{1465} = .0184$$

Intercept Corrected to Sea Surface = .124 = t

Average Refractor Depth below sea surface =

$$D = V_0 V_1 \; t/2 \sqrt{V_1^2 - V_0^2}$$

$$= .124 \cdot 1465 \cdot 2230/2000 \sqrt{4.97 - 2.15}$$

$$= .124 \cdot 3.27 \cdot 10^6 / 2000 \sqrt{2.82}$$

$$= .124 \cdot 1.635 \cdot 10^3 / 1.68 = 120.7 \text{ M}$$

From slope ratios (see Nettleton, page 270) dip component's approximately 6^o to the West.

Event B

$Z_0 = 121$ M, $V_0 = 1465$, $V_1 = 2230$

Average Intercept = (.407 + .156)/2 = .2815 sec.

Average Velocity = 3645 M/sec. = V_2

Average Intercept Corrected to Sea Surface = .300 = T_{i2}

$$Z_1 = (T_{i2} - 2 Z_0 \sqrt{V_2^2 - V_0^2} / V_0 V_2) \; V_1 V_2 / 2\sqrt{V_2^2 - V_1^2}$$

Substituting,

$$Z_1 = (.300 - 242000 \sqrt{13.29 - 2.15} / 5.34 \cdot 10^6)$$

$$\cdot 8.13 \cdot 10^6 / 2000 \sqrt{13.29 - 4.97}$$

$$= (.300 - .242 \sqrt{11.14} / 5.34) \; 4.065 \cdot 10^3 \sqrt{8.32}$$

$$= (.300 - .242 \cdot 3.34/5.34) \; 4.065 \cdot 10^3 \cdot 2.88$$

$$= (.300 - .808/5.34) \; 11.71 \cdot 10^3$$

$$= (.300 - .151) \; 11.71 \cdot 10^3 = .149 \cdot 11.71 \cdot 10^3$$

$$= 1745 \text{ M}$$

From slope ratios (see Nettleton, page 270) dip component approximately 4° to the West.

Event B

Z_0 = 121 M, V_0 = 1465, V_1 = 2230

Average Intercept = (.407 + .156)/2 = .2815 sec.

Average Velocity 3645 M/sec. = V_2

Average Intercept Corrected to Sea Surface = .300 = T_{i2}

$$Z_1 = (T_{i2} - 2 Z_0 \sqrt{V_2^2 - V_0^2} / V_0 V_2)\ V_1 V_2 / 2\sqrt{V_2^2 - V_1^2}$$

Substituting,

$$Z_1 = (.300 - 242000 \sqrt{13.29 - 2.15} / 5.34 \cdot 10^6)$$

$$\cdot 8.13 \cdot 10^6 / 2000 \sqrt{13.29 - 4.97}$$

$$= (.300 - .242 \sqrt{11.14} / 5.34)\ 4.065 \cdot 10^3 \sqrt{8.32}$$

$$= (.300 - .242 \cdot 3.34/5.34)\ 4.065 \cdot 10^3 \cdot 2.88$$

$$= (.300 - .808/5.34)\ 11.71 \cdot 10^3$$

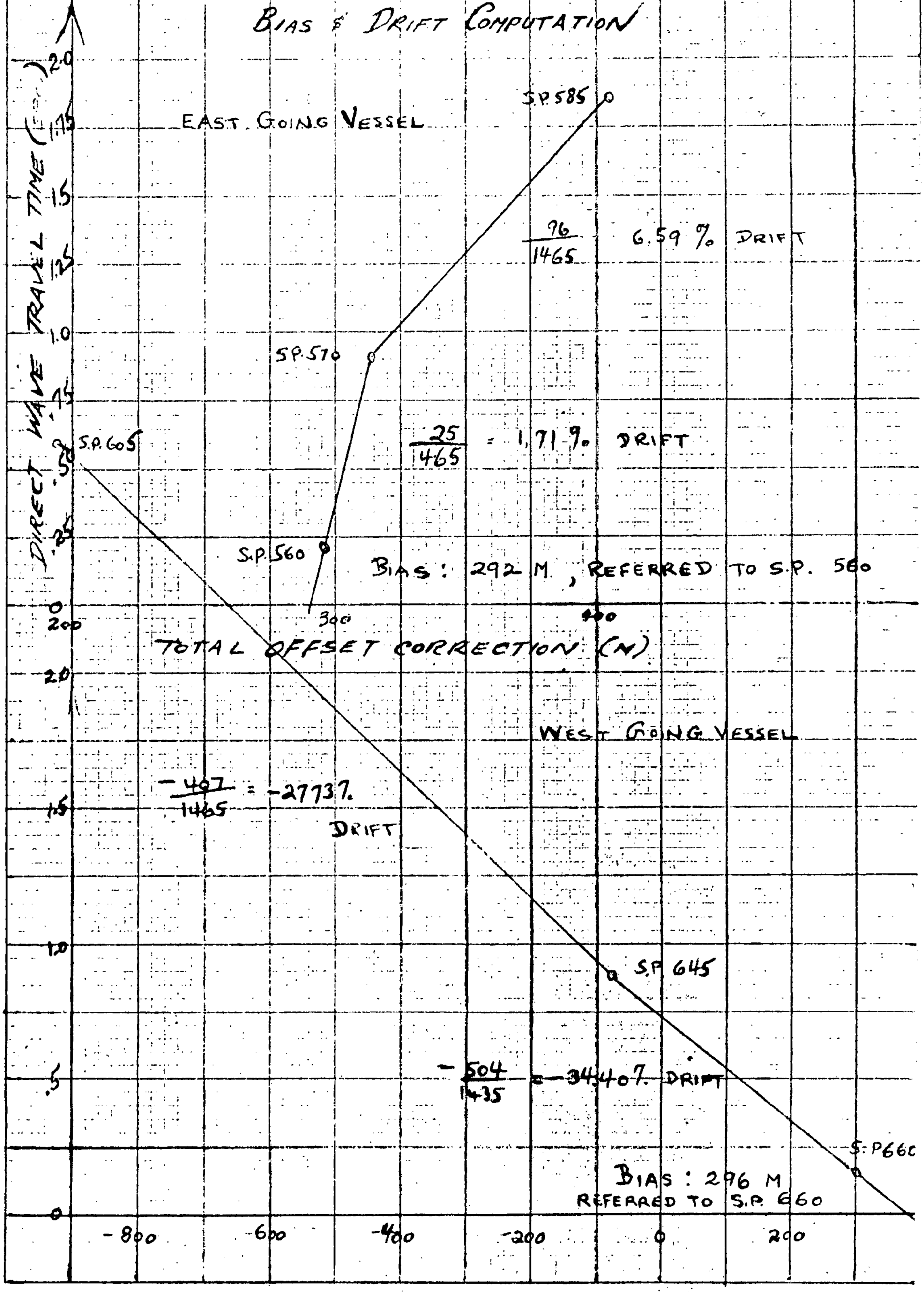
$$= (.300 - .151)\ 11.71 \cdot 10^3 = .149 \cdot 11.71 \cdot 10^3$$

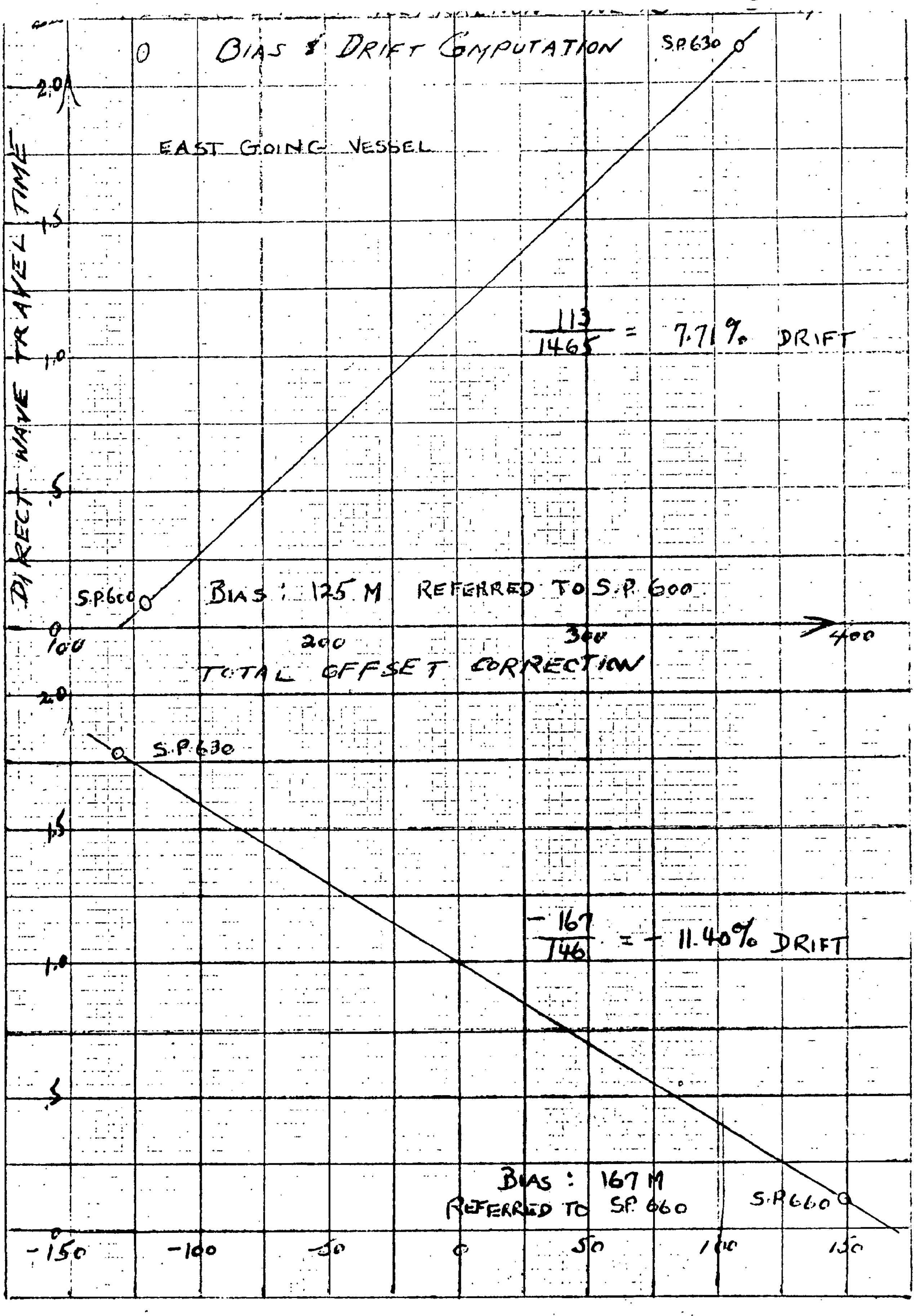
$$= 1745 \text{ M}$$

From slope ratios (see Nettleton, page 270) dip component approximately 4^o to the West.

DRIDGE OIL N.L. REFRACTION LINE 1 MAY 10

BIAS & DRIFT COMPUTATION




BIAS & DRIFT COMPUTATION
SP.630
EAST GOING VESSEL
DIRECT WAVE TRAVEL TIME
2.0
1.5
1.0
.5
0
113/1465 = 7.71% DRIFT
SP.600
BIAS : 125 M REFERRED TO S.P. 600
100
200
300
400
TOTAL OFFSET CORRECTION
S.P.630
-167/1465 = -11.40% DRIFT
BIAS : 167 M
REFERRED TO SP. 660
S.P.660
-150
-100
-50
0
50
100
150

EPP 13

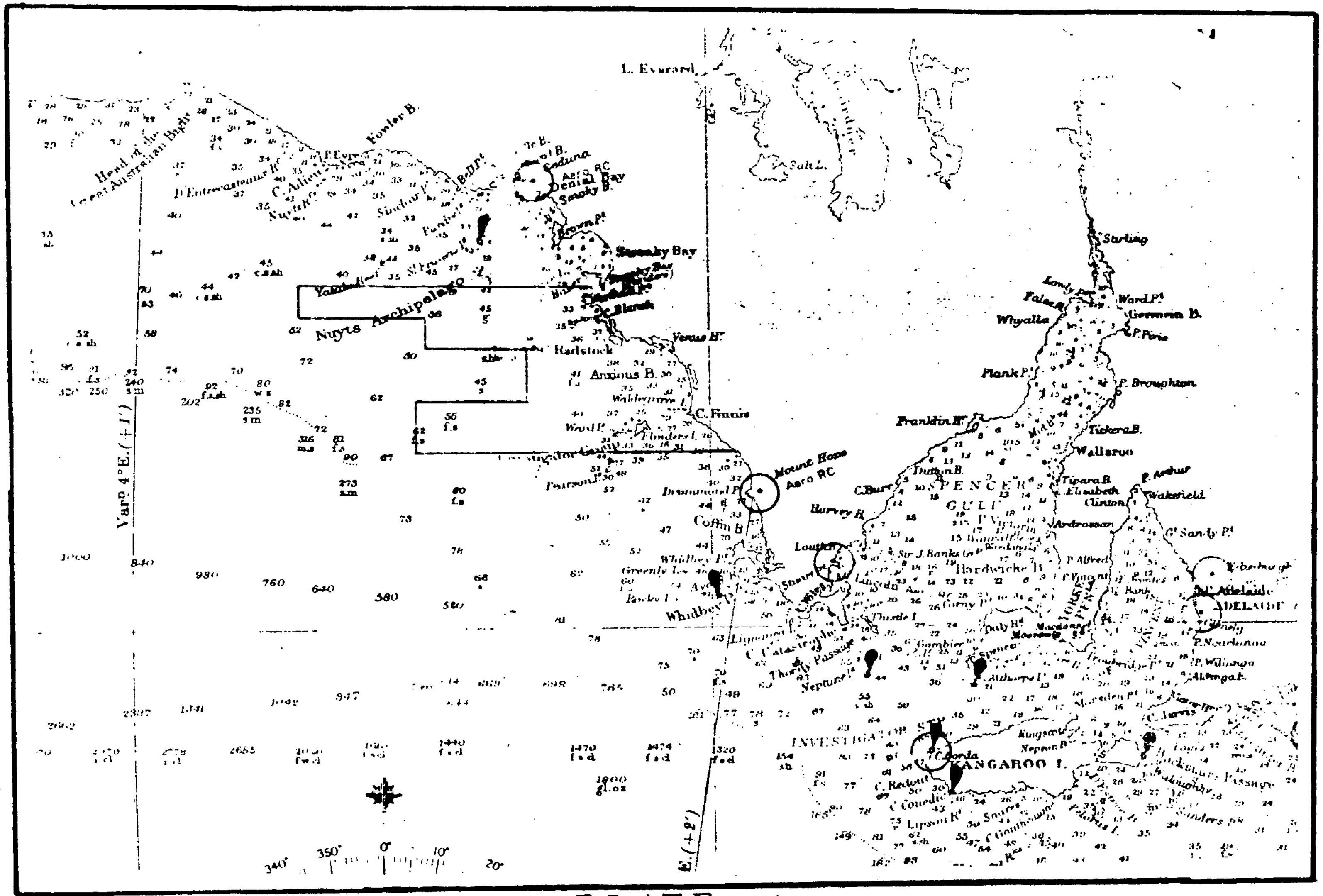
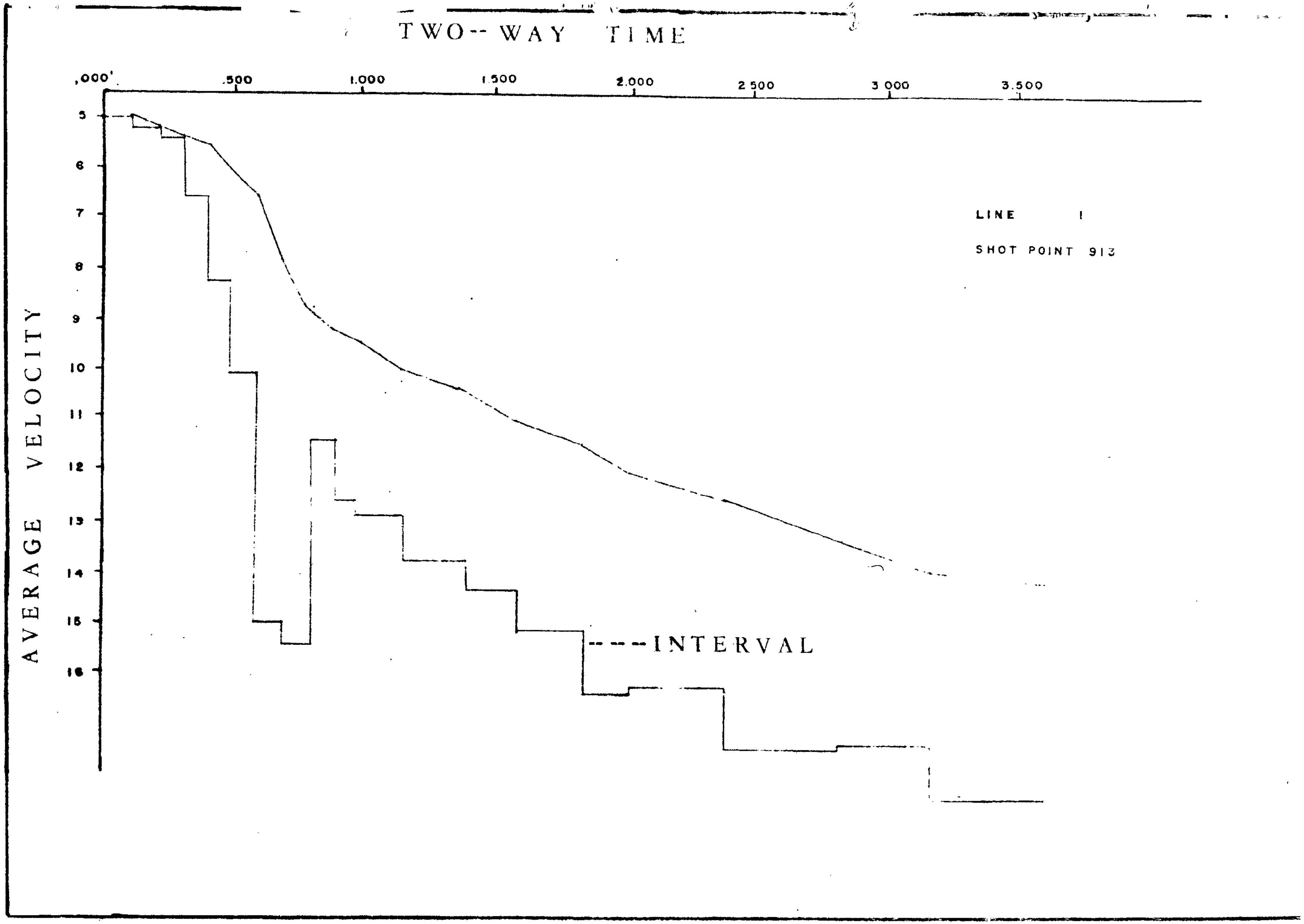


PLATE 1



TWO--WAY TIME
,000'
.500
1.000
1.500
2.000
2.500
3.000
3.500
AVERAGE VELOCITY
5
6
7
8
9
10
11
12
13
14
15
16
LINE 1
SHOT POINT 913
----INTERVAL

PLATE -- 2

PLATE 7

INTERPRETATION MAP	REVISIONS	OFFSHORE NAVIGATION, INC.
HORIZON A	DATE / INIT.	Worldwide Radiopositioning Services, New Orleans, Louisiana, U.S.A.
by TELEDYNE EXPLORATION INC. & AUSTRALIAN EXPLORATION CONSULTANTS PTY. LTD.		CLIENT: TELEDYNE EXPLORATION, INC.
CONTOUR INTERVAL .050 sec.		PRINCIPAL: BRIDGE OIL NL
JULY 1970		Scale 1:100,000 — AREA: SOUTH AUSTRALIA
		Map No. 1 of 1 — MAP PROJECTION: U.T.M. AUSTRALIA NATIONAL, ZONE 53, C.M. 135 E.
		Date 3/19/1970
		File No. P-361 AUS.

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PLATE 8

INTERPRETATION MAP	REVISIONS	OFFSHORE NAVIGATION, INC. Worldwide Radiopositioning Services New Orleans, Louisiana, U S A
HORIZON B	DATE / INIT.	CLIENT: TELEDYNE EXPLORATION, INC.
by TELEDYNE EXPLORATION INC. & AUSTRALIAN EXPLORATION CONSULTANTS PTY. LTD.		PRINCIPAL: BRIDGE OIL NL
CONTOUR INTERVAL .050 sec.		Scale 1:100,000 / AREA: SOUTH AUSTRALIA
JULY 1970		Map No. 1 of 1 / Date 3/19/1970 / File No. P-361 AUS. / MAP PROJECTION U.T.M. AUSTRALIA NATIONAL ZONE 53, C.M. 135 E.

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