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M.J. SEXTON[1], F.J. TAYLOR[1] and K.D. WAKE-DYSTER[1]

[1]Onshore Sedimentary & Petroleum Geology Program
Australian Geological Survey Organisation, GPO Box 378, Canberra, ACT 2601, Australia.

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Minister for Resources: Hon. Michael Lee, MP
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EXECUTIVE SUMMARY

The Bureau of Mineral Resources, Geology & Geophysics (now Australian Geological Survey Organisation) conducted a seismic survey in the central Eromanga Basin in Queensland from July to late November 1982. This survey was a continuation of the work undertaken in 1980 and 1981 to investigate the structure, stratigraphy, geological and tectonic evolution, and petroleum potential of the area. The survey obtained 485 km of 6-fold CMP seismic reflection data, in the Adavale Basin, Cooladdi Trough and Pleasant Creek Arch areas. Gravity observations were made at 667m intervals along the 1981 Jundah and Windorah BMR seismic lines and the 1982 seismic lines.

The seismic data which is of fair to good quality will be used in detailed stratigraphic and structural studies of the sedimentary basins.

This report presents operational information on the survey. Large scale copies (10 cm/sec, 25 traces/inch) can be purchased from the AGSO Sales Centre, G.P.O. Box 378, Canberra, A.C.T. 2601, Australia. Interpretation of the data will be published elsewhere.

INTRODUCTION

The Bureau of Mineral Resources, Geology and Geophysics (BMR) (now known as the Australian Geological Survey Organisation (AGSO)) conducted a seismic survey in the central part of the Eromanga Basin from early July to late November 1982.

The seismic survey was part of the multi-disciplinary, geoscientific research project on the central Eromanga Basin (Harrison & others, 1980), and was a continuation of the seismic programmes of 1980 (Wake-Dyster and Pinchin, 1981) and 1981 (Sexton and Taylor, 1983). The project aimed to gain knowledge of the structure, stratigraphy and lithology of the Eromanga and underlying sedimentary basins in order to study the geology and tectonic evolution of the area, and to provide basic information to assist in the exploration of the area for hydrocarbons.

The objectives of the 1982 BMR seismic survey were to extend some of the 1980 and 1981 seismic lines further east across the Adavale Basin and to provide ties between private oil company seismic traverses with a number of important petroluem exploration wells (Figure 1). Some of these objectives were discussed by Mathur and Sexton (1981).

Five seismic traverses totalling 485 km of mainly 6-fold CMP reflection coverage were recorded. These included Traverses 13, 11, 11A, 2 and a northern extension of 10. Gravity measurements were taken along these lines as well as Traverses 6, 7, 5, and 12 (1981 traverse lines). An expanding spread (Musgrave, 1962) was recorded along Traverse 10.

This report presents details of operations and preliminary results of the seismic reflection survey only. Operation statistics, spread and recording parameters, and personnel and equipment are listed in Appendices 1 to 3.

Examples of reduced scale copies of the processed seismic sections and expanding reflection spread are shown in Figures 2 and 3 respectively. Reduced scale copies of the other BMR 1982 seismic traverses are shown in Finlayson et al, 1987, with seismic sections both at 0 to 4 seconds two-way travel (TWT) time and 0 to 20 seconds TWT time.

Note: Copies of the sections at a scale of 10 cm/s are available for purchase from the AGSO Sales Centre, G.P.O.Box 384, Canberra, A.C.T. 2601, Australia.

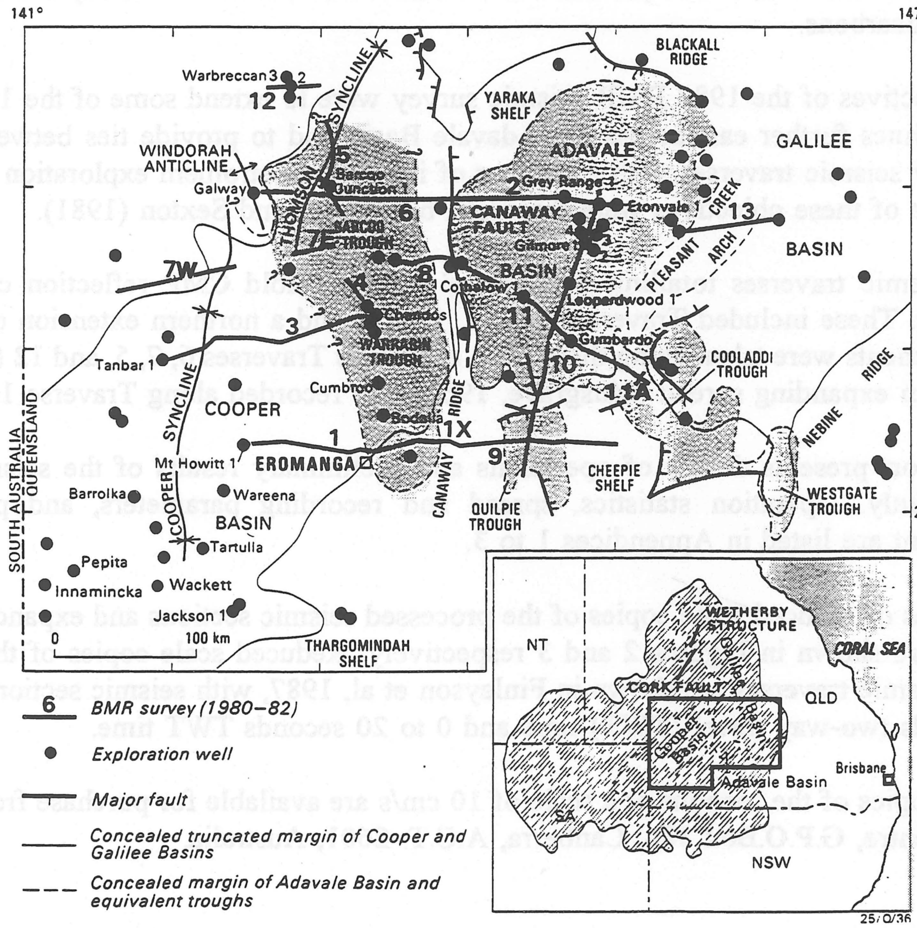

Figure 1. Location map of BMR seismic traverses, basin margins and structural elements

FIELD OPERATIONS

General

The survey area lies in south-western Queensland near the towns of Adavale, Blackall, Yaraka and Tambo, and is covered by the 1:250 000 map sheets of ADAVALE, QUILPIE and AUGATHELLA.

Operations during 1982 were hampered by the extreme dry conditions in western Queensland, the very rugged terrain over approximately 200 km of traverse line, insufficient funds for bulldozing, a flash flood in the Cudmore Valley and unreliable explosives.

Water was scarce and many landowners were not willing to allow the remaining reserves to be used for drilling purposes. Along the northern part of Traverse 10 and all of Traverse 2, the situation was critical. Fortunately, the flowing bore at Lissoy No. 1 was able to be diverted into two bulldozed pits in order to provide both camp and drilling water. Similarly a concrete dam was built on a spring in the Cudmore Valley to build up a supply of water. Water was also purchased from Emmet and Blackall.

Some traverse lines crossed 20 metre vertical cliffs as well as deep ravines. In such places, the bulldozer could not clear the line for distances up to 1 km. This coupled with the poor access along the line meant long travelling times to work and up to 7 hour round trips for drilling water. Fly camping along the traverse and a reduction of drilling depth to 27 m were implemented to improve survey progress.

The lack of sufficient bulldozing funds resulted in a very narrow, single-blade-width line being cut with widening out only at the shotpoints. Eventually even the extra clearing at the shotpoints was sacrificed in order to save funds. Consequently, it took an hour to drive from one end of the spread to the other (8 km); passing of vehicles was impossible and the damage to vehicles, tyres and seismic cables was exceptionally high.

Late in the survey, a flash flood in the Cudmore Valley stopped seismic operations for a week. All the creeks were washed out and the area was badly saturated. After the area had dried out, the bulldozer returned to rebuild the traverse line and form detours around some of the newly filled waterholes.

The most frustrating problem was the unreliability of the explosives. Appendix 4 details the explosive misfires and partial detonations. Later investigations by ICI (Australia) engineers in 1984 have shown that the velocity of detonation in ANZITE explosives is drastically reduced under a head of water. A rig and tanker were retained by the recording party to redrill holes when charges failed to detonate. This single factor was responsible for a two week delay in finishing the survey.

For the first time, computer systems were used in the field. A HP 9825 computer was used to store line profile information (shotpoints, shot depths, uphole times and elevations) as well as to calculate static corrections. A HP 1000 E-series system on a one month loan from the magnetotellurics group was used to demultiplex field tapes and perform velocity analysis. Both systems worked well and will prove invaluable on future surveys.

Bulldozing

A contract bulldozer from Quilpie was used for clearing heavy vegetation, the construction of creek crossings and creating access tracks. The bulldozer was a General Motors "Terex" machine, of "Caterpillar D7" capacity, and was well suited to the conditions encountered. Graders were used in some places to improve the condition of the traverse, but with limited funds and the dry nature of the soil, the line was normally narrow and very rough.

Surveying

Surveying was done by the Queensland Branch of the Australian Survey Office. Traverses were flagged for the bulldozer driver, pegged at 83.3 m intervals, levelled and then traversed with a theodolite and tellurometer to obtain accurate shotpoint and geophone locations.

The surveyors provided Australian Map Grid (AMG) coordinates for traverse bends and endpoints, elevations referenced to the Australian Height Datum (AHD), and latitudes and longitudes of all shotpoints.

Drilling

Five Mayhew drilling rigs were used for the entire survey. Drilling conditions varied, the main difficulty being sandy gravels along the northern part of Traverse 10. This area required the use of circulating drilling mud to prevent the holes from collapsing. In contrast to 1981, no silcrete was encountered in any of the shot holes.

Holes were generally drilled to 40 metres depth, which in most cases was below the weathering. Along Traverse 2, the hole depth was reduced to 27 metres because of the lack of drilling water. A drilling rig and water tanker remained with the recording party for the second half of the survey to redrill shot holes that failed to detonate or had insufficient energy.

Seismic Recording

Recording progressed well during the first 10 weeks but slowed in the latter part due to problems with explosives. The DFS IV seismic acquistion system had no breakdowns and only towards the end of the survey did significant cable problems develop. The dragging of seismic cables over rocky, uncleared areas caused many cuts in the PVC casing of the cables. Running over the cables was also unavoidable in many places because of the narrow width of the traverse.

Minor delays, due to inclement weather and strong winds were encountered on 4 days. The flooding of the Cudmore Valley resulted in 5 days lost production and the redrilling of shot holes caused a further 5 days delay as well as wasting several hours on many other days waiting for holes to be redrilled.

The spread and recording parameters are listed in Appendix 2 and the recording equipment in Appendix 3. Charge sizes for the survey ranged from 8 kg to 12 kg, averaging approximately 9.6 kg. All reflection shots were recorded to 20 seconds TWT time for deep crustal information.

In addition to the CMP reflection work, an expanding reflection spread (Musgrave, 1962) was shot with a maximum shot-to-geophone offset of 25 km centred on SP 1384 on Traverse 10. Table 1 lists the shot points and spread configurations used. This type of spread can be very useful in determining the average velocity to reflectors and could provide information to aid in the processing of the CMP reflection data to 20 s. Furthermore, the shooting procedure is simple and can be readily incorporated into the routine recording programme.

Gravity

Gravity measurements were taken at 667 m intervals along the 1982 traverse lines and the 1981 traverse lines in the Jundah-Windorah area. Operational details for the gravity survey are presented in Appendix 5.

Computing

Two computer systems were used in the field for the pre-processing of seismic data.

A Hewlett-Packard HP9825A calculator with General I/O, Extended I/O, String variable and Advanced Program ROM's was used to store line-profile and shooting parameters, calculate static corrections and moveups, and generate coded instructions for the contract seismic data processing company. An EPSON MX-100 Type 111 Dot Matrix Printer allowed these parameters to be tabulated and plotted.

A Hewlett-Packard HP1000 E-series computer with a 15 Mbyte HP7905 disk and an HP7970E, 1600 bpi tape transport was made available to the seismic party for a one month trial. During this period, field tapes were demultiplexed, normal moveout corrections successfully applied and attempts at "stacking" commenced. With the acquisition of this system for future surveys, field processing of 4 s data to "brute stack" stage will be possible.

SEISMIC DATA PROCESSING

Final seismic data processing of the seismic data was done under contract by Digital Exploration Limited (Digicon) in Brisbane.

Static corrections, including elevation and weathering corrections were calculated in the field using the uphole method. An elevation datum of 250 m above mean sea-level and a replacement velocity of 2000 m/s was used for all traverses. Initial stacking velocity functions to correct for moveout were calculated from field records using the T^2- X^2 method and from constant velocity plots from the HP1000 system. Trace edits, bend-point coordinates and shooting irregularities were coded in the field to provide information for producing preliminary "brute stack" seismic sections.

TABLE 1

Expanding Reflection Spread : Shotpoints and Spread Configurations

Traverse 10, Centre Shotpoint 1384

Shot No.	Shot Point No.	Charge Size	Spread Configuration Trace 48	Trace 1
1	1246	80 kg	1497	1544
2	1269	60 kg	1475	1522
3	1292	50 kg	1452	1499
4	1315	50 kg	1429	1476
5	1338	30 kg	1406	1453
6	1361	20 kg	1383	1430
7	1384	10 kg	1360	1407
8	1407	20 kg	1337	1384
9	1430	30 kg	1315	1362
10	1453	50 kg	1291	1338
11	1476	50 kg	1268	1315
12	1499	60 kg	1245	1292
13	1522	80 kg	1222	1269

All records 39 seconds in length.

TABLE 2

Processing Sequence for Seismic Sections

1. Demultiplexing and spherical divergence correction.

2. Line file computation.

3. Trace editing and CDP gather.

4. Field statics.

5. Wavelet deconvolution.

6. Brute stack using field NMO, filters and scaling.

7. Velocity analyses - one every 240 CDP's.

8. Residual statics computation.

9. Trace muting determined.

10. Preliminary final stack with residual statics, revised velocities, trace muting & scaling.

11. Velocity analyses - one every 120 CDP's.

12. Final stack with final velocities, scaling, trace muting.

13. Time-variant band-pass filtering.

14. Time-variant scaling.

15. Coherence filtering and display.

16. Wave-equation migration and display.

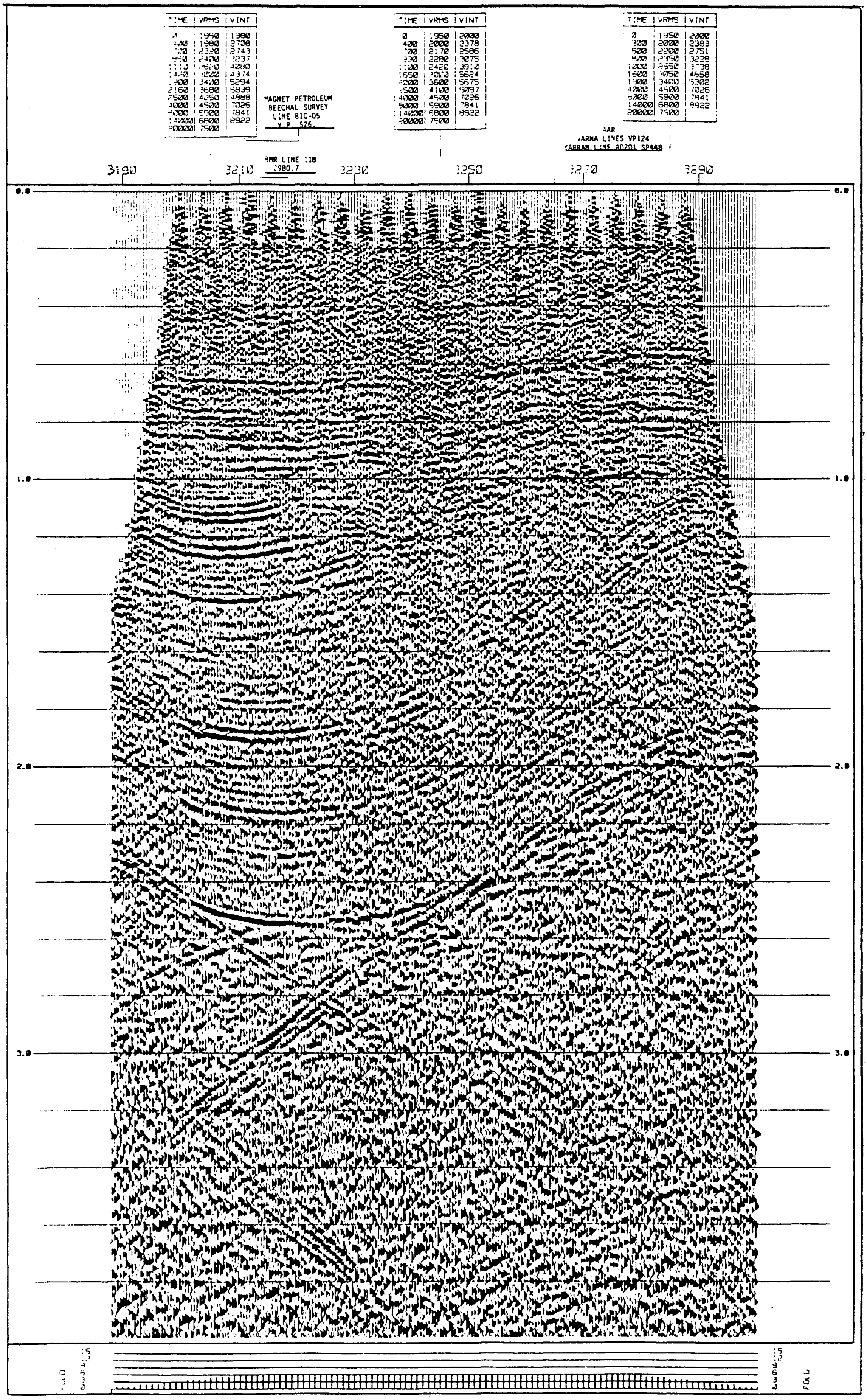

Figure 2. Seismic section, Traverse 11A.

The final seismic data processing sequence used is shown in Table 2. All lines were processed to 20 s with the first 4 s being displayed at a larger scale. The expanding reflection spread has been processed in two ways. Firstly as a display to show the various reflected and refracted events (Figure 3) and secondly as a velocity analysis which also incorporates the normal reflection records.

PRELIMINARY RESULTS

Data quality is generally fair to good (example shown in Figure 2) but in some areas where a hole could not be drilled or the charge failed to detonate, the CMP coverage fell below 6-fold and the reflection quality deteriorated.

Nevertheless, a good regional framework of seismic lines has been obtained and several interesting results have become apparent.

Traverses 2, 10 and 11 illustrate many of the main structural features of the basin, some of which have been drilled. In particular the Gilmore anticline (Traverse 10 SP 2076) is clearly outlined and its significance as the only hydrocarbon discovery in the Adavale Basin has prompted further reprocessing of analogue seismic data, and a study of the logs from the Gilmore wells.

Traverse 2 shows the onlap of the Adavale Basin onto the Yaraka Shelf and along with a network of reprocessed seismic lines should enable the nature and extent of the Adavale Basin margin to be accurately mapped in this area.

The existence of Devonian-Carboniferous sediments east of the Pleasant Creek Arch is confined to Traverse 13. The extent of this "pocket" of sediments will be investigated with the aid of several reprocessed lines and some recent seismic data collected by companies in the area.

Traverse 11 indicates that the Cooladdi Trough is actually separated from the main Adavale Basin by a faulted block, like the Quilpie Trough. Previous structure contour maps, made with sparse data show the Cooladdi Trough and Adavale Basin connected. Traverse 11A connects detailed recent seismic work by companies on the western and eastern margins of the Cooladdi Trough and should allow a detailed structural and stratigraphic interpretation of the trough to be made.

The gravity data have now been reduced to Bouguer gravity values and incorporated into the gravity data-base for the south-western Queensland region. These data will allow better quality maps of the area to be produced and aid in the future interpretations of the gravity field.

The expanding reflection spread has yielded very good velocity information for the deep-crustal portion of the seismic sections. The data are undergoing further analysis to determine interval velocities which can be used in the migration and time-to-depth conversion of the deep seismic section. The interval velocities may also place valuable constraints on the composition of the lower crust and upper mantle.

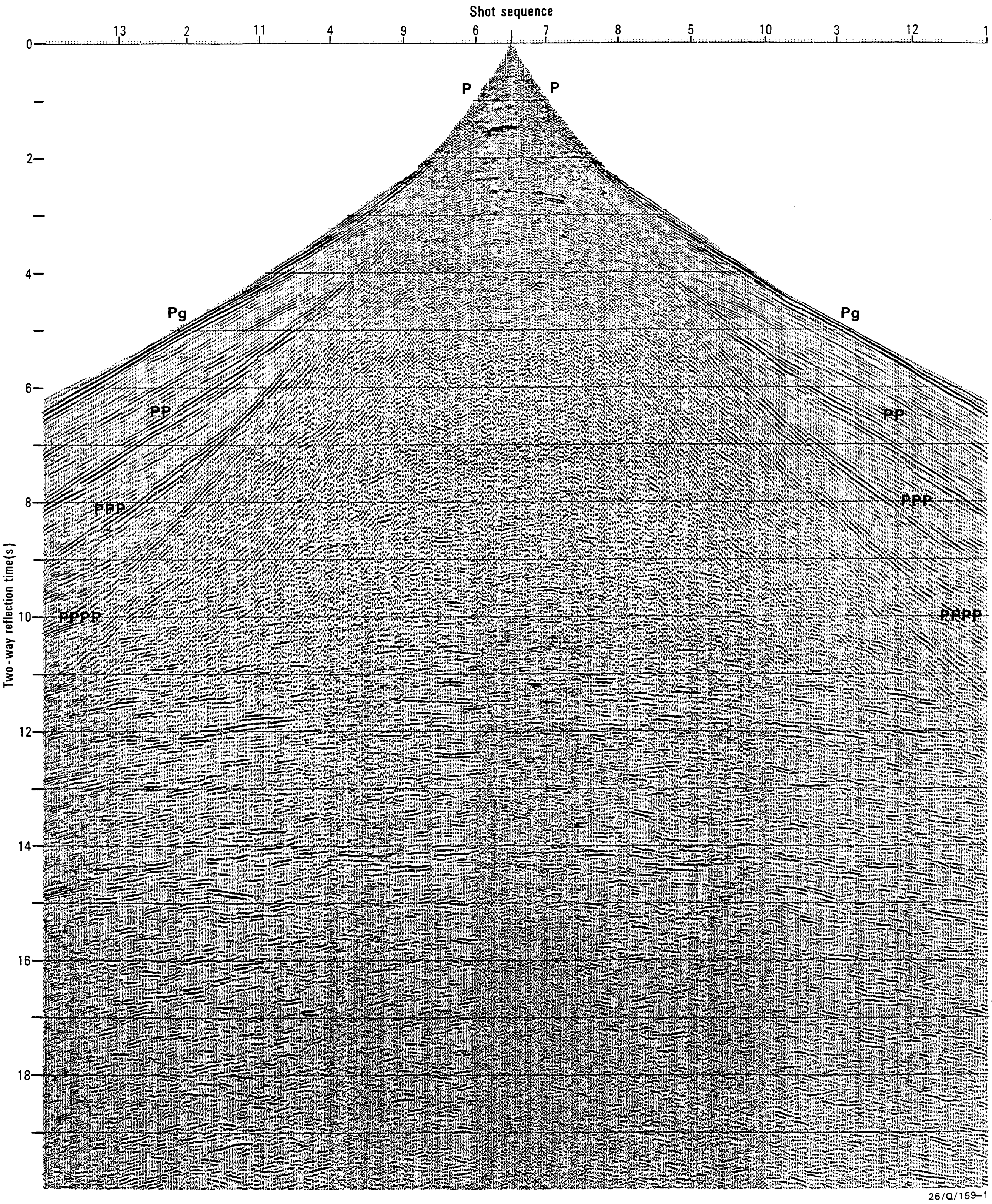

Figure 3. Expanding spread, Traverse 10, centred at SP 1384

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APPENDIX 1

Operational Statistics

Shot-hole drilling commenced	15/07/82	
Recording commenced	03/08/82	
Shot-hole drilling completed	24/11/82	
Recording completed	24/11/82	
Total length of traverses (subsurface)	485 km	
Number of recording days worked	62	
Recording days lost	26	
Due to camp shifts	14	
Due to adverse weather	4	
Due to waiting for redrills	3	
Due to flood in Cudmore Valley	5	
Multiplicity of production shots	6-fold	
Total number of shots	1522	
Total number of production shots	1426	
Average number of production shots/recording day	23.0	
Average surface coverage/recording	7.8 km	
Maximum number of production shots/recording day	42	
Total explosives used (including expanded spread)	14420 kg	Anzite Blue
Total detonators used (including expanded spread)	1744	
Total boosters used (including expanded spread)	1679	
Average charge/production shot	9.6 kg	
Total number of rig days worked	298	
Rig days lost	74	
Due to camp shifts	33	
Due to adverse weather	3	
Due to equipment breakdowns and maintenance	26	
Due to waiting for bulldozer line	2	
Due to standby for re-drills	10	

APPENDIX 2

Spread and recording parameters

Production shooting spread

Spread length and type	2000-0-1916 Split, no gap
Number of channels	48
Geophone station interval	83.333 m
Shotpoint interval	33.333 m
Multiplicity	6-fold CMP
Number of geophones/trace	16
Geophone pattern	in-line
Geophone spacing in line	5.5 m

DFS IV instrument settings

Recording mode		Digital, P.E.
Format		SEG-B
Number of input channels		48 data, 4 auxiliary
Tape		9 track, 1600 bpi PE, 1/2 in
Record length		20 s
Sample rate		2 ms
Gain constant		42 dB
Input filters, production	lo cut :	8 Hz, 36 dB/octave
	hi cut :	124 Hz, 72 dB/octave
Notch filter		out
Reproduce module settings, production		
Defloat mode :	galvo level	15
	hi-cut	90 hz
	lo-cut	12 hz
AGC mode :	galvo level	15
	hi-cut	60 hz
Trip sensitivity		36 dB
Trip delay		1.0 s

APPENDIX 3

Personnel and Equipment

Personnel

Geophysical Branch

Party Leaders	O. Dixon (GSQ) (July)
	F.J. Taylor (July-Oct)
	M.J. Sexton (Oct-Nov)
Party Manager	J.A. Somerville (July-Nov)
Geophysicists	B.R. Goleby (Aug-Oct)
	R. Hegarty (GSQ) (Aug-Oct)
	F. Bruvel (GSQ) (Oct-Nov)
Technical Officers (ESU)	G. Jennings (November)
	C. Rochford (Aug-Nov)
Technical Officers (Science)	G. Price (July-Nov)
	D. Pfister (Oct-Nov)
	N. Pedvin (Aug-Oct)
Technical Assistant	D. Johnstone
Field Assistants (Explosives)	R.D.E. Cherry
	A.C. Takken
	S. Howard
Mechanic	D.K. McIntyre
Wages Hands	14

Petroleum Exploration Branch

Toolpusher	E.H. Cherry
Drillers & Assistants	E. Lodwick
	T. Shanahan
	A. Zoska
	R. Clark
	D. Eaton
	G. Ferrie
	M. Simon
	A. Maher
	P. Mewburn
	W. Reeves
	F. Ceichan
Wages Mechanics	J. Keyte
	B. Rafferty

Australian Survey Office

Surveyors	1
Technical Officers	3
Chainmen	6

Equipment

Recording system	TI DFS-IV
Camera	SIE ERC-1OC
Switch gear	I/O Rotalong
Radio firing unit	I/O RFU
Cables	539 m, 48 ch - 18 cables
Geophones	GSC, 20D, 8 Hz - 128 sets
Transceivers	Codan 6924 - 6
	Phillips FM 828 - 8
Gravity meter	Worden W169

Vehicles

Recording truck	1 x International D1610 3 ton 4 x 4
Workshop trucks	2 x International D1610 3 ton 4 x 4
Flat-top trucks	4 x International D1610 3 ton 4 x 4
Water tankers	2 x International D1610 3 ton 4 x 4
Drilling rigs	5 x Mayhew 1000/Mack 6 x 8 trucks
Drilling water tankers	5 x Mack R875, 6 x 6, 1900 gallon
Shooting truck	1 x Landrover LWB, 4 x 4, Tray-top
Personnel carriers	5 x Toyota Troop Carriers, 4 x 4
Geophone carriers	3 x International D1310, 30 cwt. 4 x 4
Stores truck	1 x International D1310, 30 cwt. 4 x 4
Pre-loading truck	1 x Landrover LWB, 4 x 4, Tray-top
Office van	1 x 4 wheel
Kitchen van	2 x 4 wheel
Ablutions van	2 x 4 wheel
Stores trailers	2 x 4 wheel
Generator trailers	1 x 4 wheel
Drill trailer	1 x 2 wheel
Drill mechanics trailer	1 x 4 wheel, 6 tonne
Water Trailers	2 x 2 wheel, 200 gallon

APPENDIX 4

Seismic Traverse Details, Line Intersections & Well Ties

1. BMR Traverse Details

BMR Traverse	km	Shotpoint Range	Comments
2	108	2672 - 3972	High SP numbers to the West.
10 (1982)	125	0980 - 2484	High SP numbers to the North.
11A	9	3188 - 3300	High SP numbers to the East.
11	173	1102 - 3173	High SP numbers to the East, Pts 11B,C,D
13	72	1312 - 2180	High SP numbers to the East.

2. Seismic Line Intersections

BMR Traverse 2	SP 2801	-	BMR Traverse 10	SP 2362
BMR Traverse 11C	SP 1844.7	-	BMR Traverse 11D	SP 1770.7
BMR Traverse 11B	SP 2344	-	BMR Traverse 11C	SP 2312.3
BMR Traverse 11	SP 2127.6	-	BMR Traverse 10	SP 1301.2
BMR Traverse 11	SP 2980.7	-	BMR Traverse 11A	SP 3213
BMR Traverse 11	SP 1103	-	BMR Traverse 8	SP 8237
BMR Traverse 2	SP 3941.5	-	BMR Traverse 6	SP 7723.7
BMR Traverse 11A	SP 3211	-	Beechal 81C-05	VP 526
BMR Traverse 11A	SP 3277	-	Yarran AD-201	SP 448

3. Well Ties

Petroleum Exploration Well	Seismic Line Intersection	
Gilmore 1	BMR Traverse 10	SP 2076
Lissoy 1	BMR Traverse 10	SP 2361
Leopardwood 1	BMR Traverse 10	SP 1678
Yongala 1	BMR Traverse 11	SP 1120 (100 m SW)
Cothalow 1	BMR Traverse 11	SP 1845
Gumbardo 1	BMR Traverse 11	SP 2370
Stafford 1	BMR Traverse 13	SP 1325
Westbourne 1	BMR Traverse 13	SP 2176
Etonvale 1	BMR Traverse 2	SP 2670
Lissoy 1	BMR Traverse 2	SP 2800
Grey Range 1	BMR Traverse 2	SP 3121

APPENDIX 5

Explosives: Misfires and Partial Detonations

Traverse Number	Shot point	Problem
13	1371	Partial detonation
(3/8/82-13/8/82)	1392	" "
	1400	" "
	1404	Detonator only
	1848	" "
	1892	" "
	2040	" "
	2168	" "
11	1692	Detonator failure
(19/8/82-23/9/82)	2100	Detonator only
	2184	" "
	2228	" "
	2432	" "
	2656	Partial detonation
	2688	" "
	2696	Detonator only
	2720	" "
	2732	" "
	2812	Partial detonation
	2816	" "
	2968	Detonator only
	3056	" "
	3128	Partial detonation
	3156	" "
	3164	" "
	3168	" "
11A		All OK
24/9/82		
10	1104	Partial detonation
30/9/82-26/10/82	1112	" "
	1128	Detonator only
	1144	" "
	1156	" "
	1160	Partial detonation
	1172	Detonator only
	1212	" "
	1268	Detonator failure
	1280	Detonator only
	1284	Partial detonation
	1300	" "
	1336	" "
	1344	" "

	1392	" "
	1412	" "
	1416	" "
	1424	" "
	1432	" "
	1444	" "
	1456	" "
	1460	Partial detonation
	1468	" "
	1476	" "
	1480	" "
	1484	" "
	1497	" "
	1512	" "
	1584	" "
	1594	" "
	1600	" "
	1604	" "
	1624	Detonator failure
	1704	Partial detonation
	1916	" "
	1924	" "
	1936	" "
	1944	" "
	1956	" "
	1960	" "
	2112	" "
	2116	" "
	2140	" "
	2144	" "
	2152	" "
	2204	" "
	2304	" "
	2312	" "
	2368	" "
	2392	" "
2	2668	" "
27/10/82-24/11/82	2676	" "
	2728	" "
	2788	" "
	2836	" "
	2852	" "
	2868	" "
	3020	Detonator only
	3028	" "
	3036	Partial detonation
	3076	" "
	3084	" "

3092	" "
3096	" "
3116	" "
3408	Detonator failure
3448	Partial detonation
3456	" "
3624	Detonator only
3812	Detonator failure
3844	Detonator

Note: On Traverses 10 and 2, redrills were done at most places where 2 or more closely spaced charges failed.

APPENDIX 6

Operational details, Gravity survey

1. The survey commenced on 27th July 1982 and was completed on 25th November 1982.

2. 1084 new stations were read.

3. Worden W169 (calibration factor 0.10112) was used.

4. The survey was tied to the following base station:

Station	Value	Location
6491058	978008.29	Quilpie Airport

5. All stations were seismic shot-point or geophone locations and levels were optically obtained to Third-Order standard.

6. Gravity observers included N. Pedvin, D. Pfister and D. Johnstone.