BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Record 1983/10

Central Eromanga Basin seismic reprocessing, 1981

Operational Report

by

M.J. Sexton, K.D. Wake-Dyster, D. Gardner, and D.W. Johnstone

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CONTENTS

ABSTRACT

The Bureau of Mineral Resources, Geology and Geophysics (BMR) is conducting seismic surveys in the central Eromanga Basin during 1980 to 1982. To complement the 6-fold CDP seismic reflection data being collected by the BMR, a programme of reprocessing old analogue seismic data is being undertaken. These data are from traverses recorded over the Quilpie, Barcoo and Warrabin Troughs and the Canaway Ridge.

The original field data were recorded on either SIE-FM or Techno-AM analogue tapes. These were transcribed at the BMR onto 9 track digital tapes using either the MS-42 playback equipment or the PMR-20 field system and the DFS IV digital seismic system. Static corrections and a velocity function for normal moveout corrections were computed and supplied to Geophysical Services Incorporated (G.S.I.) for contract processing.

The improvement in quality of the sections is generally very good and when tied to the higher resolution 6-fold CDP data should allow a more detailed stratigraphic and structural interpretation of these areas than was previously possible.

INTRODUCTION

Senior and others (1978) defined the central Eromanga Basin as the area from 24°S to 29°S and from 141°E to 147°E. It includes twenty 1:250 000 sheet areas (Figure 1). During the 1960s seismic exploration was undertaken along a large number of traverses in this area and the major structural features delineated (Figure 2). Phillips Petroleum and Sunray DX Oil Company had leases east of the Canaway Ridge and concentrated their attention on the Devonian Adavale Basin and its associated Quilpie and Cooladdi Troughs. West of the Canaway Ridge, Alliance Oil Development and British Petroleum Development recorded seismic reflection data over the northern end of the Warrabin Trough. Further north Marathon Petroleum (Australia) shot several long lines over the Thomson Syncline.

A great deal of these data show reasonable reflections at depth on the monitor records, but the reflections lack good correlation from record to record on the final seismic sections.

Since these data were collected, many improvements have been made in seismic processing and display techniques. It was considered worthwhile to utilise the advances in seismic technology over the past 20 years and reprocess some of these early data.

The data chosen were recorded along traverse lines that could be tied to the 6-fold seismic reflection data being recorded by the BMR during 1980 to 1982 (Wake-Dyster and Pinchin, 1981; and Sexton and Taylor, 1983). The areas of immediate interest are the Quilpie and Warrabin Troughs, the Thomson Syncline and the Canaway Ridge. The relative locations of the traverses to the BMR traverses in these areas are illustrated in Figure 2 and relevant reprocessing information about each of the traverses are listed in Table 1.

The original seismic data were recorded on either SIE-FM or Techno-AM analogue tapes. These were transcribed at the BMR onto 9 track SEGB digital tapes using either the MS-42 analogue playback equipment or the PMR-20 field system and the DFS IV field seismic

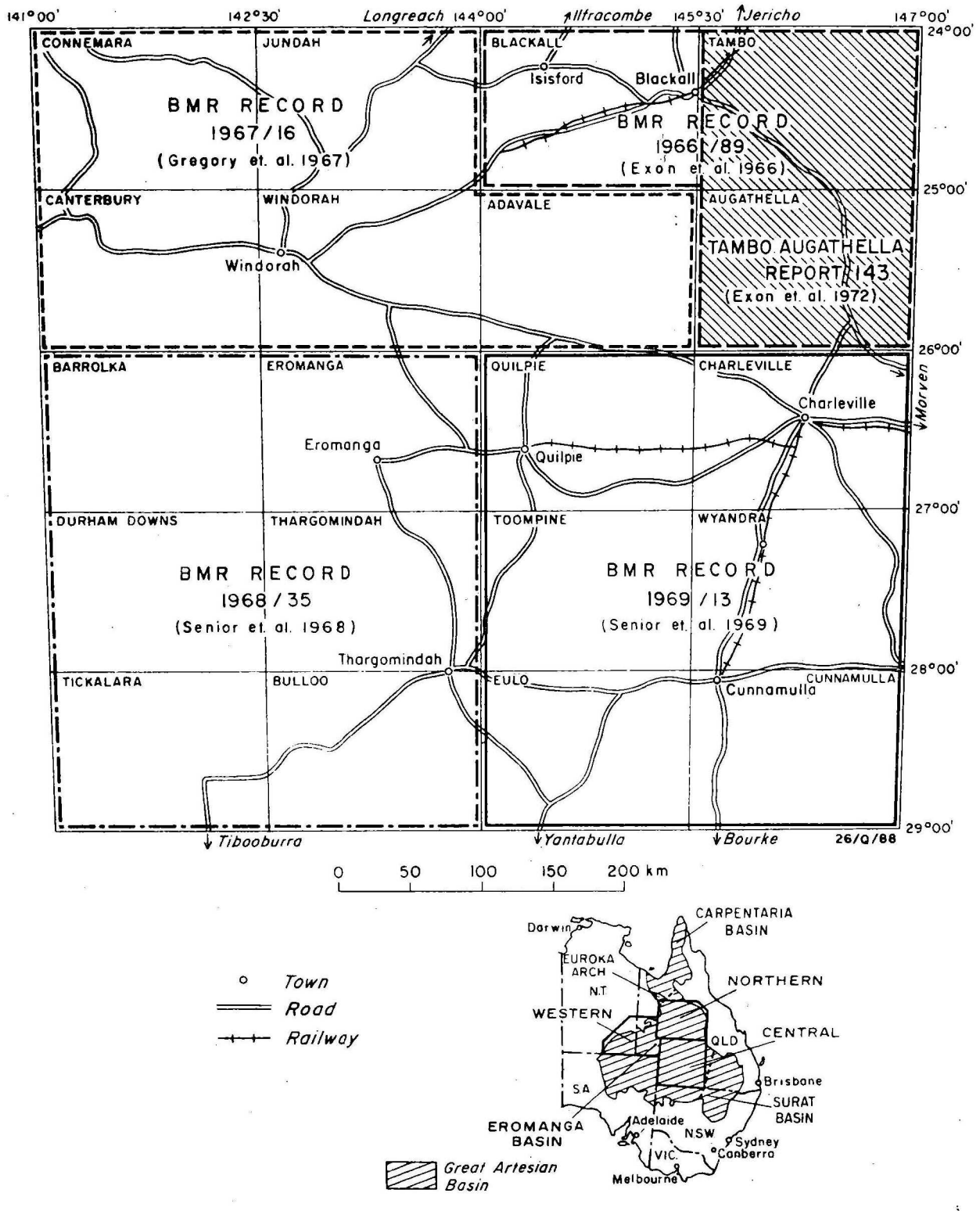

Fig. 1 Location map and key to Explanatory Notes, BMR Report and Record Series

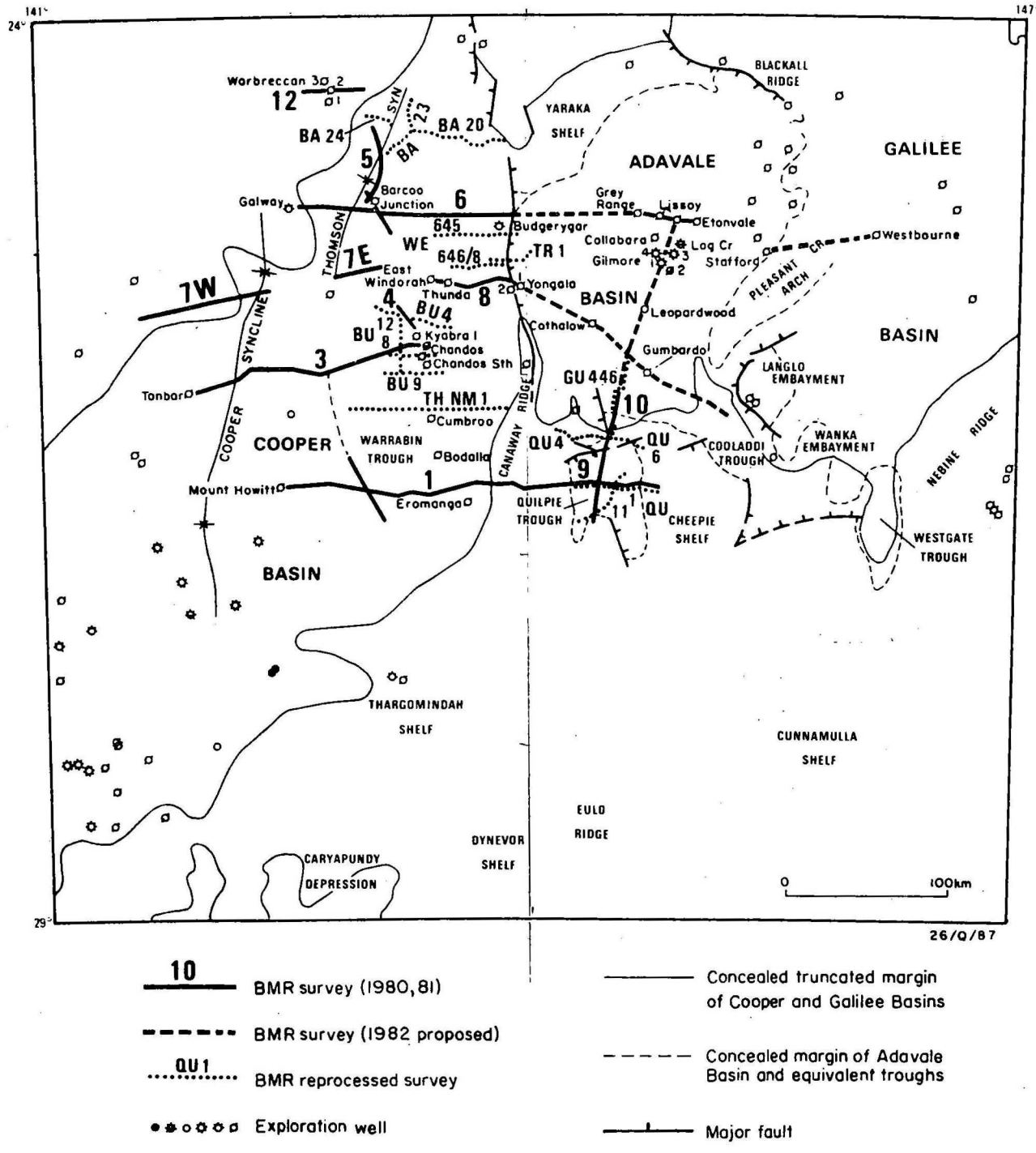

Fig. 2 Central Eromanga Basin: BMR seismic coverage and reprocessing, showing exploration wells and major structures

system. The transcribed tapes were processed by Geophysical Services Inc. (G.S.I.) in Sydney. Some reduced scale copies of the reprocessed seismic sections have been included in this report.

Note: Copies of the sections at a vertical scale of 10cm/s are available from the Copy Service, Government Printer (Production) G.P.O. Box 84, Canberra (Attention Mrs Misins).

OPERATIONS

The SIE-FM and Techno-AM analogue tapes required separate transcription systems. The SIE tapes were played back using the PMR-20 portable magnetic recording system, whereas the Techno tapes used the MS-42 playback system. The setups were similar for both types of tapes. Appendix 1 presents details of the more commonly used PMR-20-DFS IV transcription system. Briefly, the trace signals from the analogue magnetic tapes are demodulated, amplified to levels similar to geophone outputs and fed into the input modules of the DFS IV. A pulse from the cam switch on the analogue recorder starts the DFS IV recording.

An "Observer's Report" was constructed from the original observers' reports, tape logs and monitor records. Static corrections were calculated using the uphole technique and a set of instructions prepared for contract processing at G.S.I. Unfortunately some of the original reports are incomplete and it became a major task to compile these instructions.

Initial velocity functions for normal moveout corrections, calculated at the BMR using the T^2-X^2 method were supplied to G.S.I. where a brute seismic section was produced. Velocity analyses were then made every 20 records, and with the refined velocity functions, autostatics, deconvolution and filtering, final seismic sections were produced. The processing sequence is listed in Table 2.

SEISMIC DATA QUALITY

The reprocessed sections are a marked improvement over the original sections. Some of the original sections were only "wiggly-line"

displays on which it is very difficult to interpret reflecting horizons. A good example of this is shown in Figures 3a and 3b which show a portion of Barcoo line 23B. On the reprocessed section the older Devonian sequence can be clearly seen whereas it is not immediately evident on the original section.

Improvement is further illustrated on segments of Thylungra line NM1. Figures 4a and 4b show the original and reprocessed sections of a central portion of line NM1. The reprocessed section is significantly better than the original. The application of deconvolution and filtering operators to the data have removed much of the "ringing" which is evident on the original. The improvement in structural information is again illustrated by Figures 5a and 5b from the eastern part of line NM1.

Examples of the reprocessed sections from the Welford, Barcoo and Trinidad surveys are shown in Figures 6, 7 and 8. These sections are of good quality and will help in planned, detailed interpretations of the Thomson Syncline and Canaway Ridge areas.

No original sections were available for the Quilpie and Gumbardo lines. Thus reprocessing was the only alternative. As these two surveys were amongst the earliest recorded in this area, it is considered that if original sections existed they would be poor in quality. Nevertheless, the reprocessed sections (Figures 9 and 10) are quite good and clearly show the underlying Devonian-age sequence.

The reprocessed seismic lines described in this report tie to 6-fold CDP lines being recorded by the BMR during 1980 to 1982. Further reprocessing is planned during 1982 which will extend the coverage over large areas of the central Eromanga Basin, and enable a number of important well ties to be made to allow detailed stratigraphic and structural interpretations in these areas.

CONCLUSIONS

The reprocessing of old analogue seismic data has enabled more information to be extracted at a fraction of the cost it would take to re-record them. Furthermore in the reprocessing, the problems

of datum shifts and various reducing velocities between different surveys can be eliminated. This greatly aids interpretation, as not only are the seismic sections of better quality but they are all reduced to the same datum using the same velocity.

REFERENCES

SENIOR, B.R., MOND, A., & HARRISON, P.L., 1978 - Geology of the Eromanga Basin. Bureau of Mineral Resources, Australia, Bulletin, 167.

SEXTON, M.J., & TAYLOR, F.J., 1983 - Central Eromanga Basin seismic survey, Queensland, 1981: Operational Report: Bureau of Mineral Resources, Australia, Record 1983/? (unpublished).

WAKE-DYSTER, K.D., & PINCHIN, J., 1981 - Central Eromanga Basin seismic survey, Queensland, 1980: Operational Report: Bureau of Mineral Resources, Australia, Record 1981/22 (unpublished).

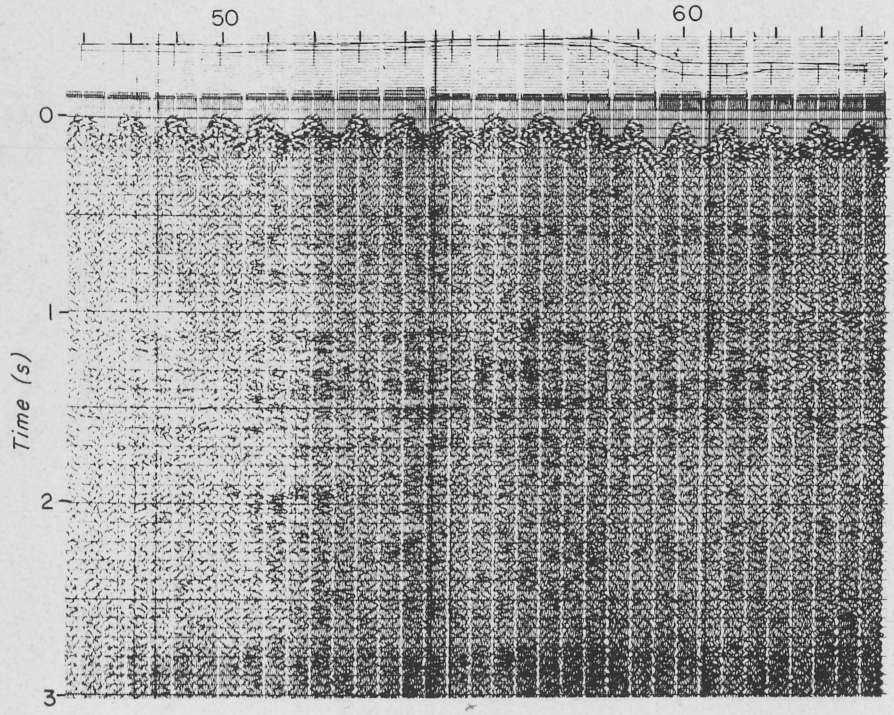

Fig 3a Original seismic section, Barcoo line 23B

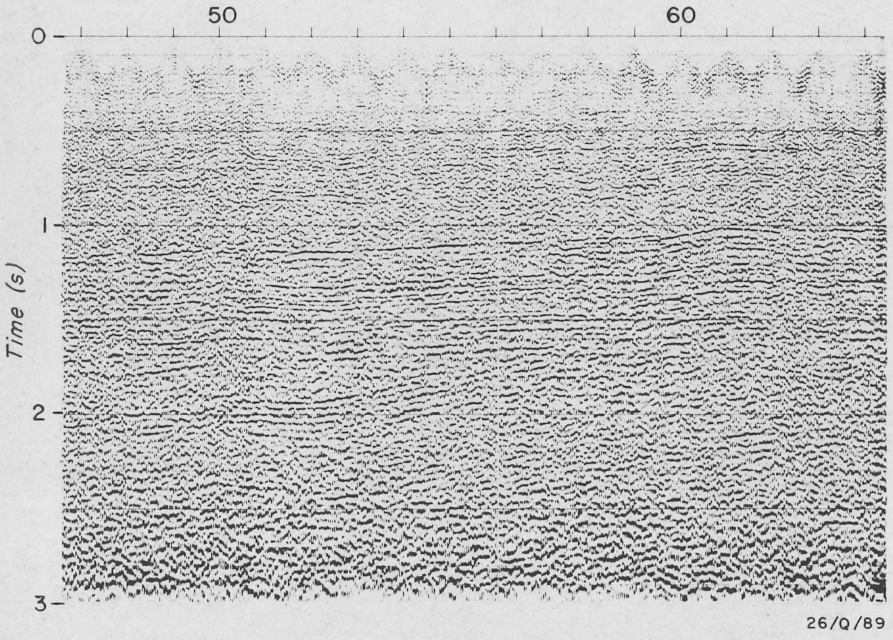

Fig 3b Reprocessed seismic section, Barcoo line 23B

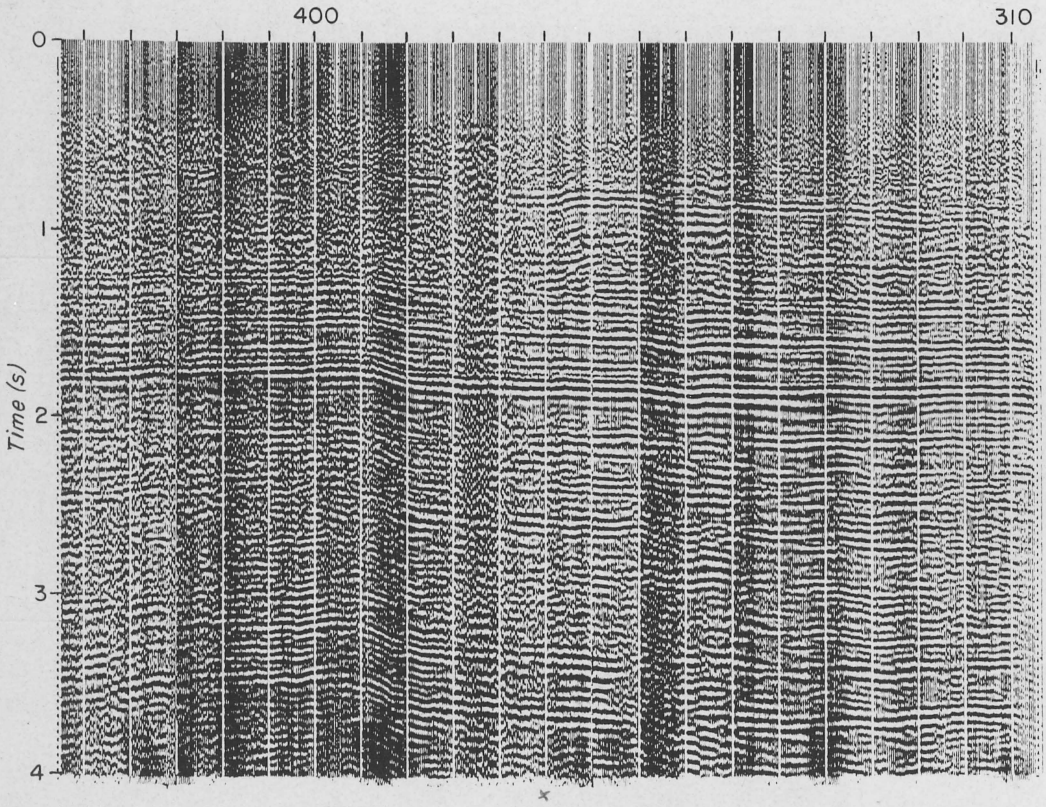

Fig 4a Original seismic section, Thylungra line NM1

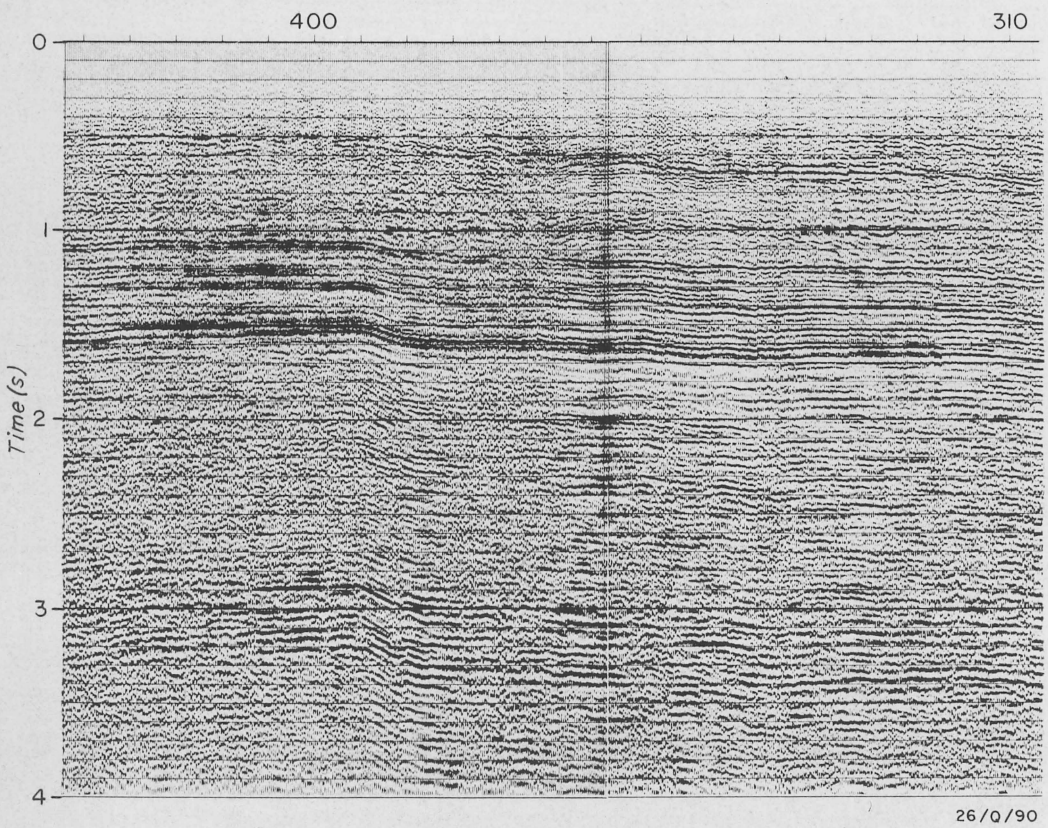

Fig 4b Reprocessed seismic section, Thylungra line NM1

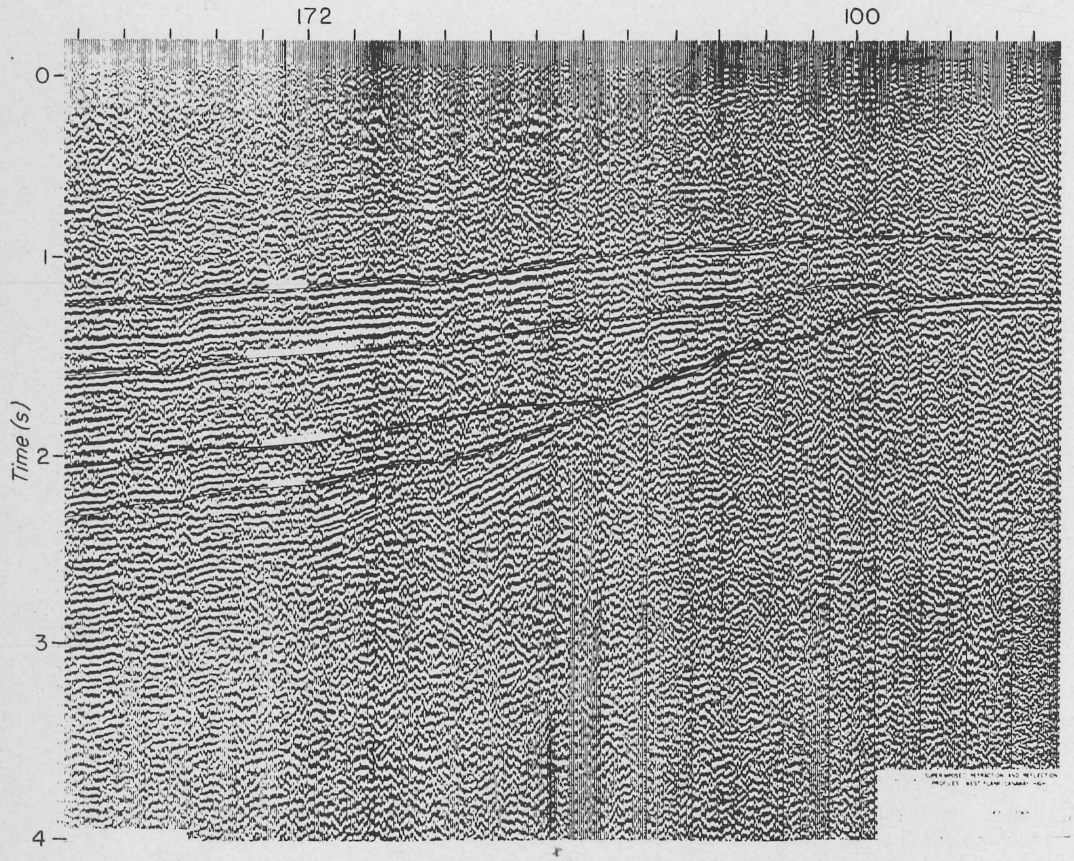

Fig 5a Original seismic section, Thylungra line NM1 (east end)

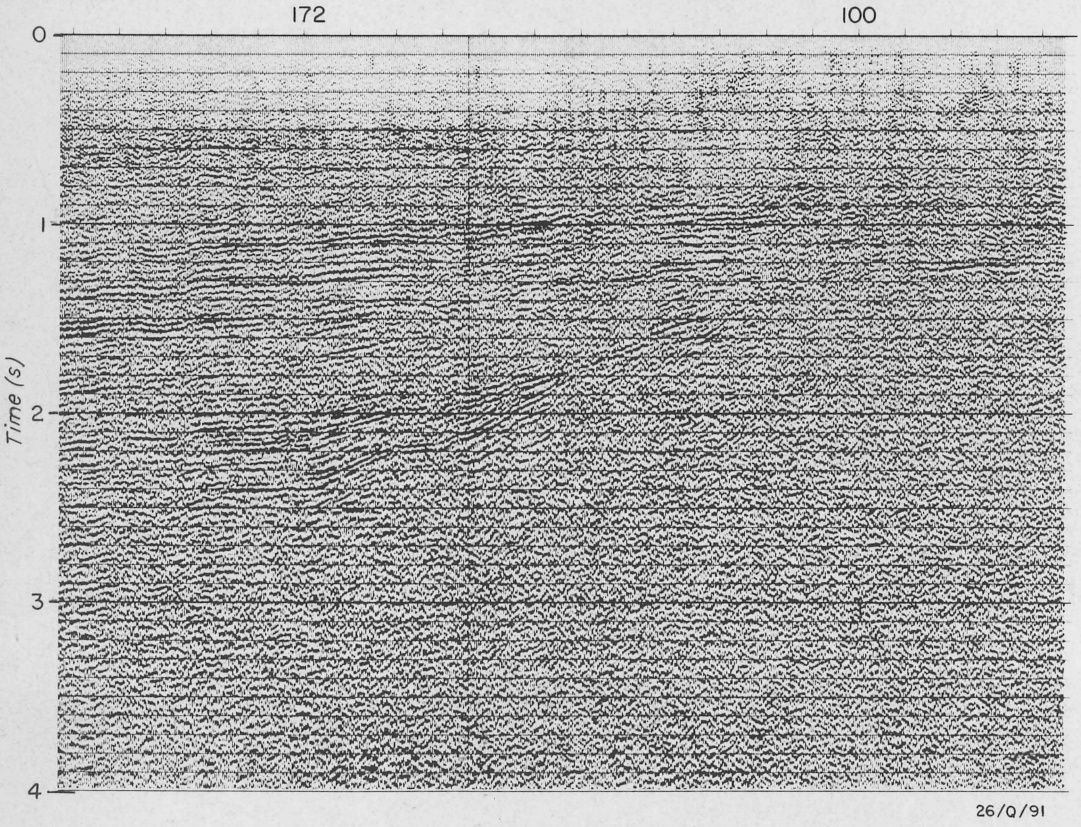

Fig 5b Reprocessed seismic section, Thylungra line NM1 (east end)

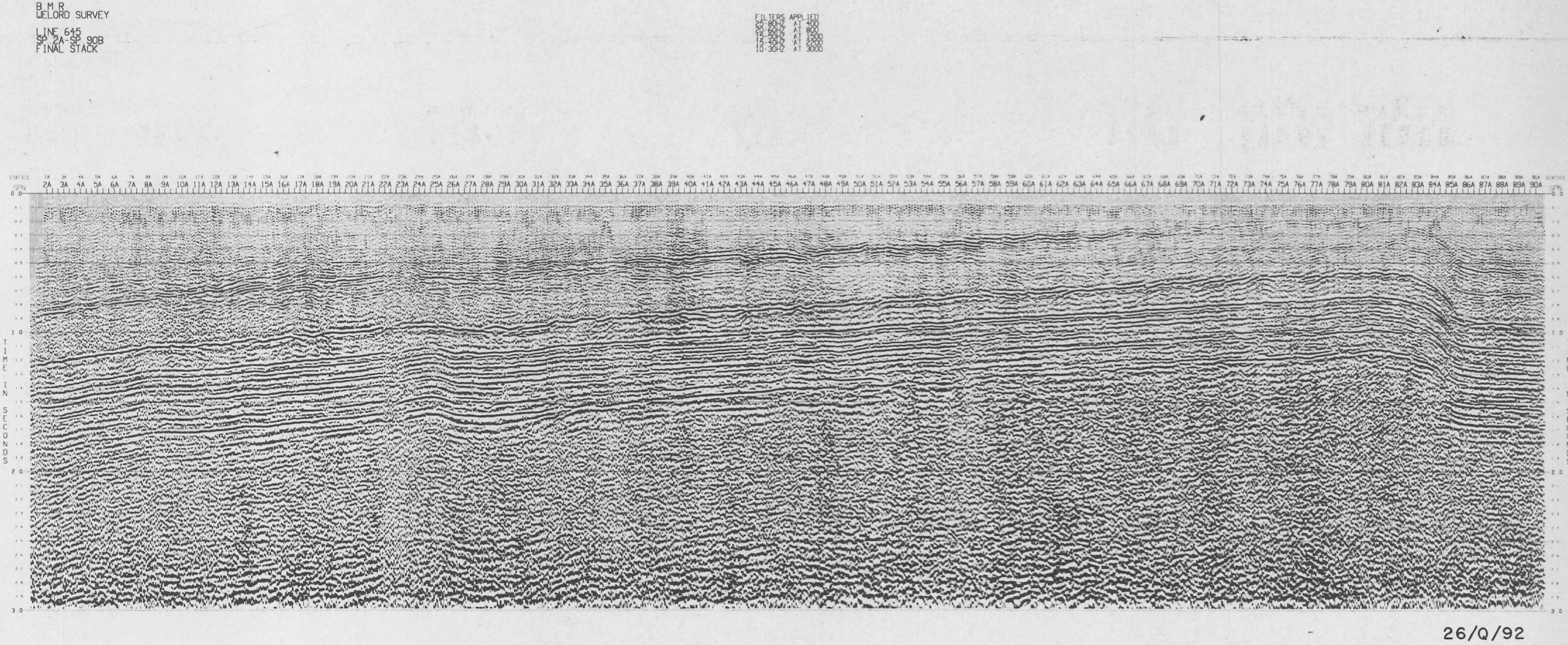

Fig 6 Seismic section, Welford survey - line 645

BUREAU MINERAL RESOURCES

BARCOO SURVEY

LINE BC24B

SPS 101 - 134

FIELD RECORDING PARAMETERS

CABLE	GEOPHONE TYPE	ELECTRO TECH EVS 2
	ARRAY	18 GEO/TRACE IN LINE
	IN LINE OFFSETS	1800-150-0-150-1800
	GROUP INTERVAL	150 FEET
SOURCE	DYNAMITE	40-120 LBS
	DEPTH	150-200 FT
	SP INT	1950 FT
	MULTIPLICITY	12 FOLD
INSTRUMENTS		TECHNO 401A
	FIELD FORMAT	ANALOGUE
	FILTERS LO	18 HZ
	HIGH	134 HZ
PROGRESSION	SPLIT SPREAD	TOWARDS TRACE 1

RECORDED BY UNITED GEOPHYSICAL CORPORATION

DATE RECORDED 1965

GEOPHYSICAL SERVICE INTERNATIONAL

DIGITAL PROCESSING CENTRE
SYDNEY NSW AUSTRALIA

PROCESSING PARAMETERS

PROCESSING DATUM 600FT ASL
REPLACEMENT VELOCITY 7000FT SEC

1 ANALOGUE TO DIGITAL TRANSCRIPTION BY BMR
2 STATIC COMPUTATION BY GSI
3 GAIN RECOVERY
4 PRELIMINARY SECTION WITH SUPPLIED VELOCITIES
5 VELOCITY ANALYSIS ... VELPAK EVERY 20 RECORDS
6 RESIDUAL STATIC DETERMINATION
7 NORMAL MOVEOUT CORRECTION
8 TIME VARIANT DECON ... WHITENING 4%44MSEC OP
9 TIME VARIANT FILTER
25-80HZ AT 0 0SEC 25-80HZ AT 0 4SEC
20-60HZ AT 0 8SEC 15-50HZ AT 1 6SEC
12-40HZ AT 2 0SEC 10-30HZ AT 3 0SEC
10 TIME VARIANT SCALING
GATE LENGTH 500 500 1000 1000MS
GATE START 300 700 1100 2000MS

DISPLAY

MODE	WIGGLE TRACE/VAR 20% CLIP
VERTICAL SCALE	10CM/SEC
HORIZONTAL SCALE	10 TR/IN

DATE PROCESSED JUNE 1981

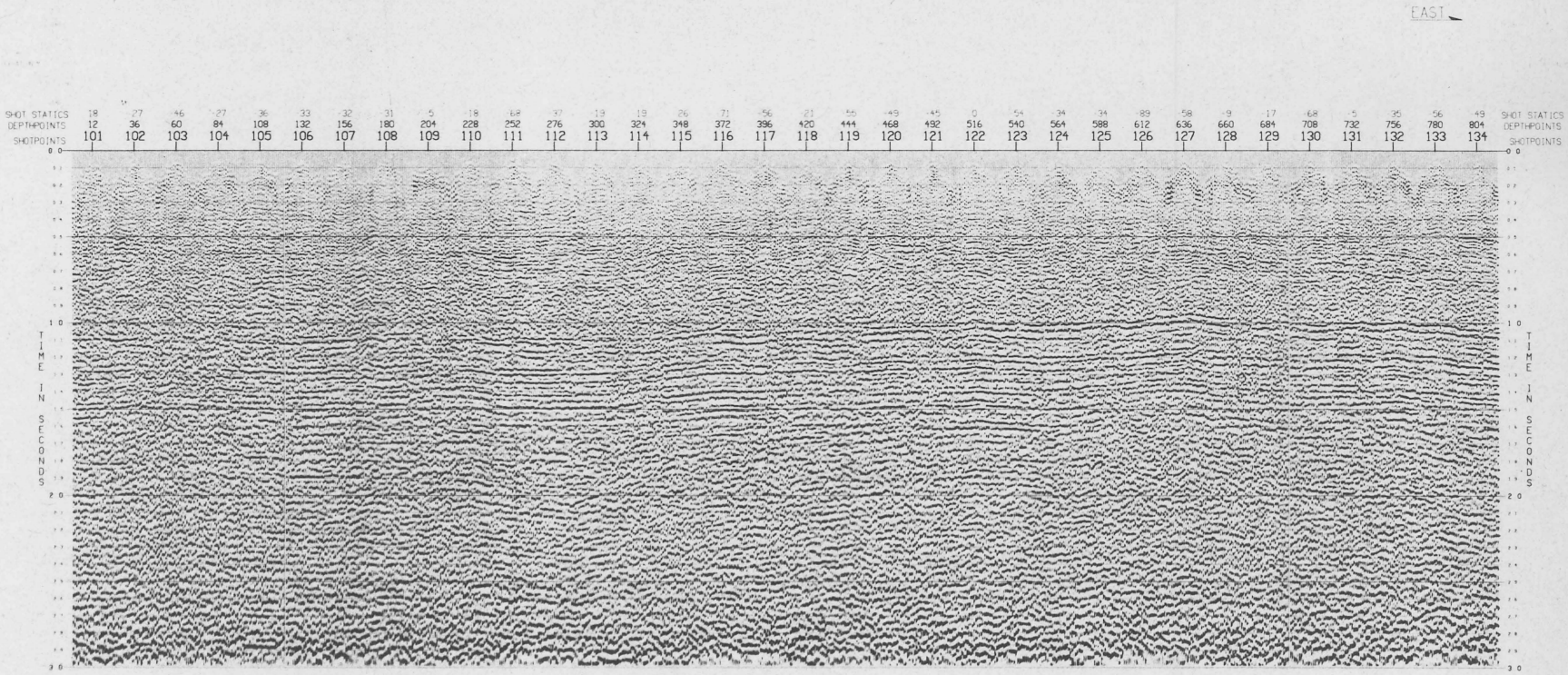

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Fig. 7 Seismic section, Barcoo survey - line 24B

BUREAU MINERAL RESOURCES

TRINIDAD SURVEY

LINE TRIN-1

SPS 1 - 38

FIELD RECORDING PARAMETERS

CABLE	GEOPHONE TYPE	ELECTRO TECH EVS-2
	ARRAY	12 GEO/TRACE IN LINE
	IN LINE OFFSETS	687-721-0-73-1687 FT
	GROUP INTERVAL	147 FEET
SOURCE	DYNAMITE	3 LBS
	DEPTH	100 FT
	SP INT	150'
	MULTIPLICITY	1 FOLD
INSTRUMENTS		TI-DYNO 401A RECORDE
	FIELD FORMAT	ANALOGUE
	FILTERS LO	19 HZ
	HIGH	91 HZ
PROGRESSION SPLIT SPREAD		TOWARDS TRACE 24

RECORDED BY PARTY 84 NAMCO INT INC

DATE RECORDED 1964

GEOPHYSICAL SERVICE INTERNATIONAL

DIGITAL PROCESSING CENTRE
SYDNEY NSW AUSTRALIA

PROCESSING PARAMETERS

PROCESSING DATUM 600FT ASL
REPLACEMENT VELOCITY 7000FT SEC

1 ANALOGUE TO DIGITAL TRANSCRIPTION BY BMR
2 STATIC COMPUTATION BY BMR
3 GAIN RECOVERY
4 PRELIMINARY SECTION WITH SUPPLIED VELOCITIES
5 VELOCITY ANALYSIS VELPAK EVERY 20 RECORDS
6 RESIDUAL STATIC DETERMINATION
7 NORMAL MOVEOUT CORRECTION
8 TIME VARIANT DECON WHITENING 4X44MSEC OP
9 TIME VARIANT FILTER
20-80HZ AT 0SEC 75-80HZ AT 0.4SEC
20-60HZ AT 0.8SEC 15-50HZ AT 1.2SEC
15-40HZ AT 2.2SEC TO 30HZ AT 3.0SEC
10 TIME VARIANT SCALING
GATE LENGTH 500 500 1000 1000MS
GATE START 300 700 1100 2000MS

DISPLAY

MODE	WIGGLE TRACE/VAR	20% BIAS
	VERTICAL SCALE	10CM/SEC
	HORIZONTAL SCALE	10 TPCM

DATE PROCESSED JNUE 1981

P.H. Bruyn

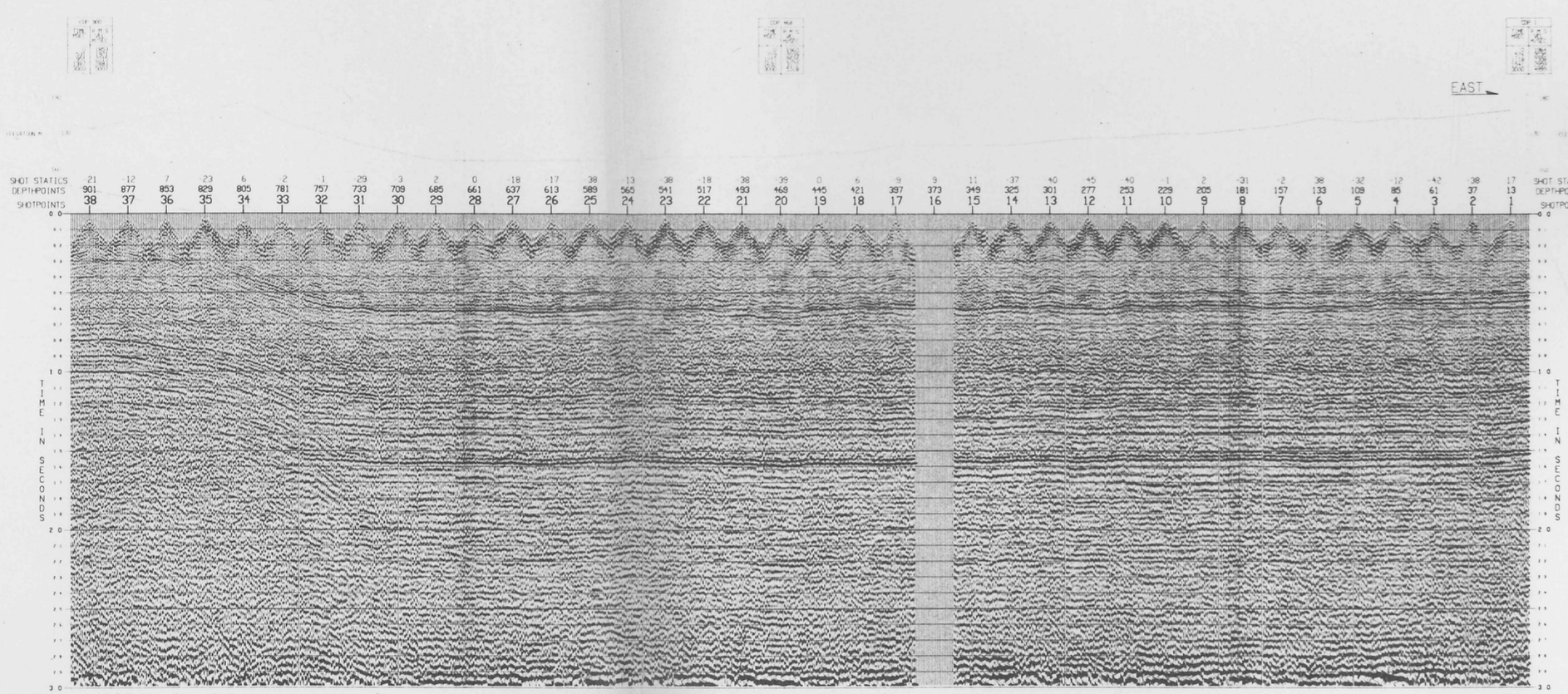

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Fig 8 : Seismic section, Trinidad survey - line 1

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QUILPIE SURVEY

LINE QLP-11

SPS 875 - 5008

FIELD RECORDING PARAMETERS

DATE RECORDED 1962

GEOPHYSICAL SERVICE INTERNATIONAL

PROCESSING PARAMETERS

DISPLAY

DATE PROCESSED JULY 1981

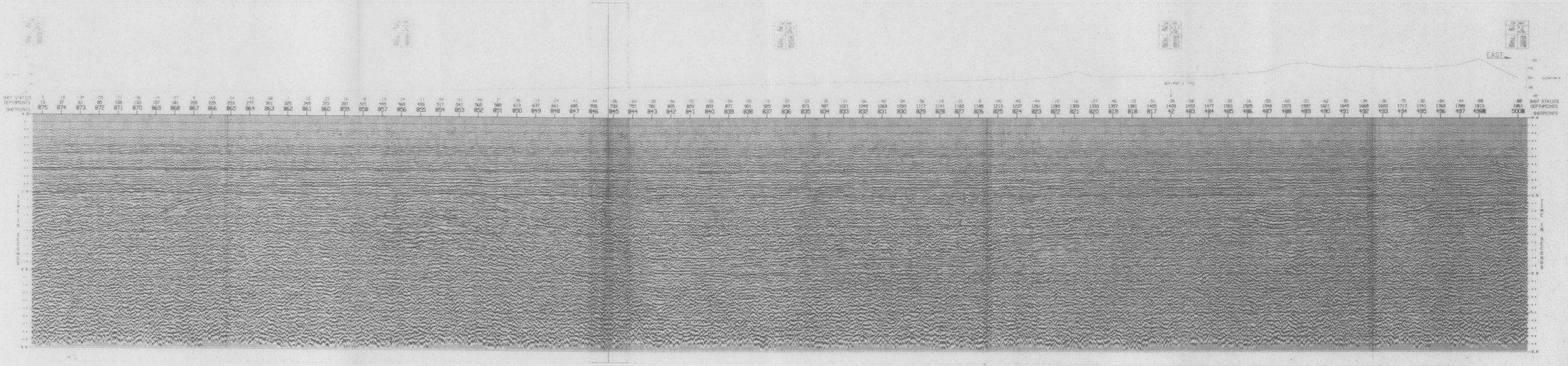

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Fig. 9 Seismic section, Quilpie survey - line 11

BUREAU MINERAL RESOURCES

GUMBARDO SURVEY

LINE G-446

SPS 7416-7500

FIELD RECORDING PARAMETERS

CABLE	GEOPHONE TYPE	HALL-SEARS HS-1
	ARRAY	H PATTERN 16 TRACE
	IN LINE OFFSETS	1745-145-0-145-1740
	GROUP INTERVAL	145 FEET
SOURCE	DYNAMITE	150 LBS
	DEPTH	100 FT
	INT	RMS
	MULTIPLICITY	16 FOLD
INSTRUMENTS		DFS IV S/S 15A
	FIELD FORMAT	ANALOGUE
	FILTERS LO	20 HZ
	HIGH	90 HZ
PROGRESSION SPLIT SPREAD		TOWARDS TRACE 1

RECORDED BY PETTY GEOPHYSICAL ENGINEERING CO

DATE RECORDED 1962

GEOPHYSICAL SERVICE INTERNATIONAL

DIGITAL PROCESSING CENTRE
SYDNEY NSW AUSTRALIA

PROCESSING PARAMETERS

PROCESSING DATUM 600FT ASL
REPLACEMENT VELOCITY 7000FT SEC

1 ANALOGUE TO DIGITAL TRANSCRIPTION BY BMR
2 STATIC CORRELATION BY BMR
3 GAIN RECOVERY
4 VELOCITY ANALYSIS WITH SUPPLIED VELOCITIES
5 VELOCITY ANALYSIS GENERATION EVERY 20 RECORDS
6 NORMAL MOVEOUT CORRECTION
7 DECONVOLUTION WHITENING 4X44MSEC OP
8 TIME VARIANT FILTER
20-90HZ AT 0.0SEC 12-80HZ AT 1.0SEC
20-90HZ AT 0.0SEC 12-50HZ AT 3.0SEC
10 TIME VARIANT SCALING 2SEC 10-30HZ AT 3.0SEC
GATE LENGTH 500 500 1000 1000MS
GATE START 500 700 1100 2000MS

DISPLAY

MODE VARIABLE TRACE/VAR 70% BIAS
VERTICAL SCALE 125MM/SEC
HORIZONTAL SCALE 18 TRACE

DATE PROCESSED JULY 1981

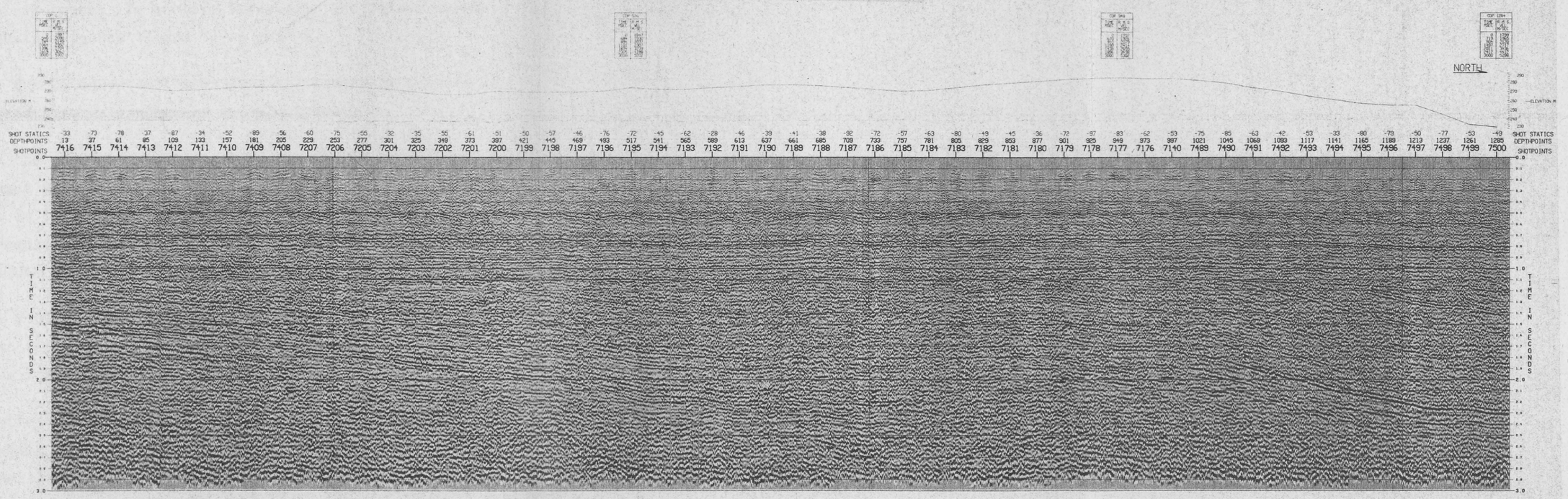

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Fig 10 : Seismic section, Gumbardo survey - line 446

APPENDIX 1

Conversion of DFS IV for transcription operation

In converting the DFS IV from normal recording mode to that needed for transcription the aim is to have the playback output level of the PMR-20 similar to that of a geophone signal. Furthermore, the DFS IV has to be converted to 24 channel operation as the analogue tapes are 24 channel tapes. To achieve these aims the following steps should be taken using Figures 11 and 12 as guides.

1. Remove the 24 unwanted traces from the camera by turning the respective galvanometers anticlockwise.

2. Remove the unwanted 24 channels of the DFS IV amplifier. As the input modules for channels 25-36 and 37-48 provide easier access it is achieved by:

   Removing P304A and P304B and transferring P304C into J304A and P304D into J304B.

3. Remove P101 from the input modules 3 and 4 of the DFS IV and connect leads J8 and J9 from the PMR-20 to J101 of the input modules 3 and 4.

4. Dismantle P205 (the Remote Control plug of the format module) and solder J1 (the auxiliary control lead of the PMR-20) to pins 13 and 14 of P205. This connection puts the cam start switch of the PMR-20 in parallel with the start switch of the DFS IV.

5. Connect pins C and D of J3 (PMR-20) to pins 10 and 12 of the A1 card (auxiliary input of the amplifier module card). Ensure that the posts E1 and E16 of A1 are also connected.

6. Open the format module plane and do the header plug conversion as given on pages B-3, B-9 and B-14 of the DFS IV manual "NINE TRACK FORMAT MODULE - VOLUME I OF II (LOW RATE). Particular attention is drawn to NOTE 1 on page B-3, i.e. "Install in LOC K05 (pin 8 of network in pin 13 of K05)".

7. Alter the tape transport speed as outlined on pages 1-4 of the "NINE TRACK FORMAT MODULE MANUAL, VOLUME I OF II" and pages 5-7 of the "TAPE TRANSPORT MODULE MANUAL". For 24 channel operation using format B, 1600 bpi the following tape speeds are used:

Sample interval (ms)	Tape Speed (IPS)
1	46.25
2	23.12
4	11.56

8. This completes the conversion of the DFS IV to transcription operation. Before production starts, several tests should be made to ensure optimum results, These include:

(a) a weekly test of the DFS IV system;

(b) a PMR-20 level check, which involves playing back a 20-Hz test tape on the PMR-20 and adjusting the level trimpot on the demodulator units of the PMR-20. This is described on pages 2-5 and 2-7 of the PMR-20 Manual (delete paragraphs G and H).

(c) The settings for tape transcription are:

DFS IV FORMAT MODULE:

Data Record Length 5 seconds

DFS IV INPUT MODULE:

Low cut - Out
High Cut - 62Hz
Notch - Out

PMR-20:

SW1 in Playback Amp Position.

9. Recording

After switching on, record the first analogue tape as a normal field recording. For subsequent records, hold the

over-ride button down on the DFS IV and start the recording by pressing the start button on the PMR-20. This is to overcome the FTB (field time break) interlock of the DFS IV.

10. If the move-out on the monitor record doesn't look correct then the two input cables from the PMR-20 to the DFS IV have been transposed and should be swapped. The system should now be operational for tape transcription.

NOTE: The following manuals held at BMR have been cited:

1. DFS IV NINE TRACK FORMAT MODULE, VOLUME I OF II
   Texas Instruments. Manual No.226640-9701, 1974

2. DFS III TAPE TRANSPORT MODULE OPERATORS MANUAL
   Texas Instruments Manual No.222502-0001, 1975

3. PMR-20 MAGNETIC RECORDING SYSTEM MANUAL
   Dresser SIE, Inc. Manual No.SIE#138399
   BMR Manual No.ZSR 020

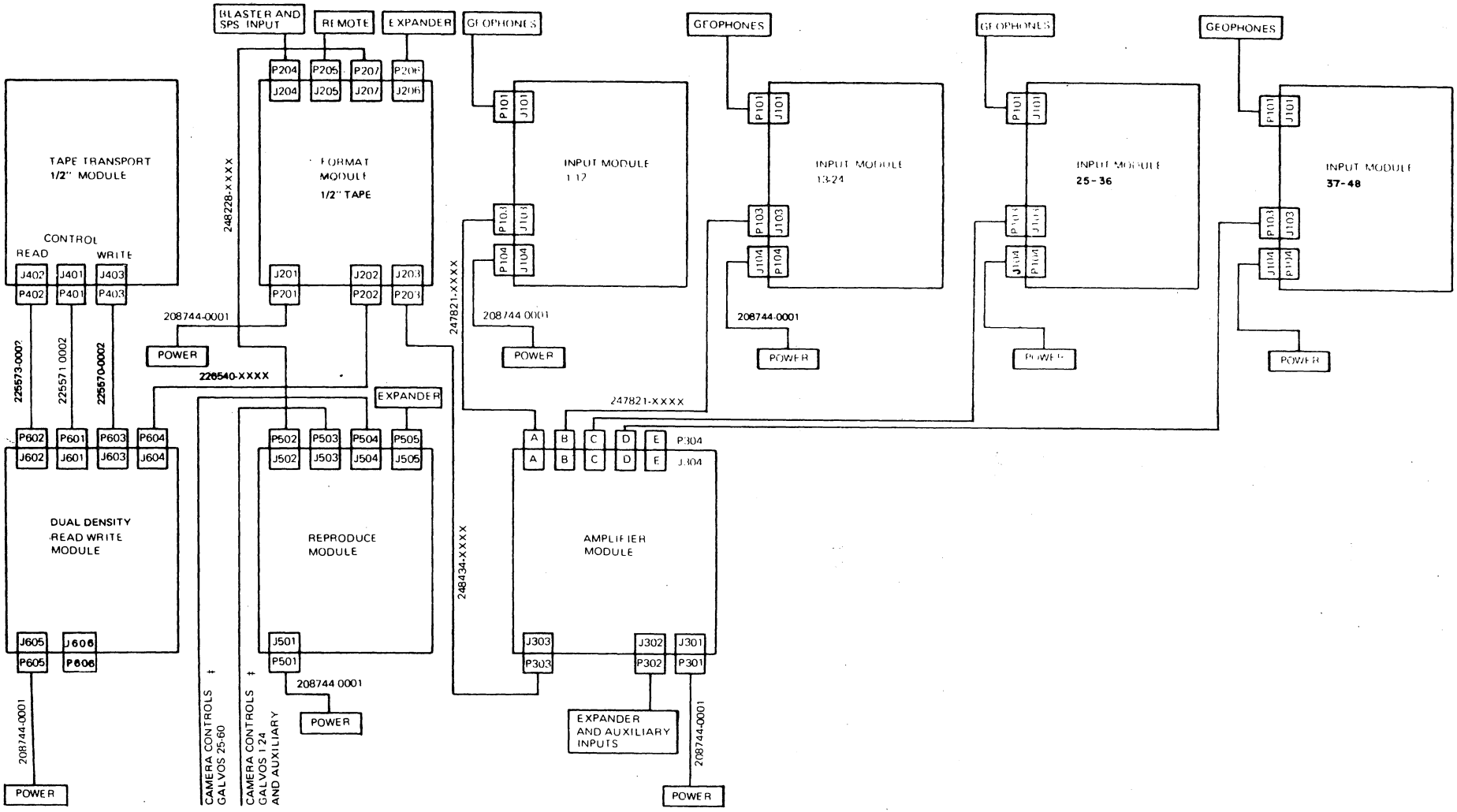

Fig.11 Normal DFS IV, 48 channel operation

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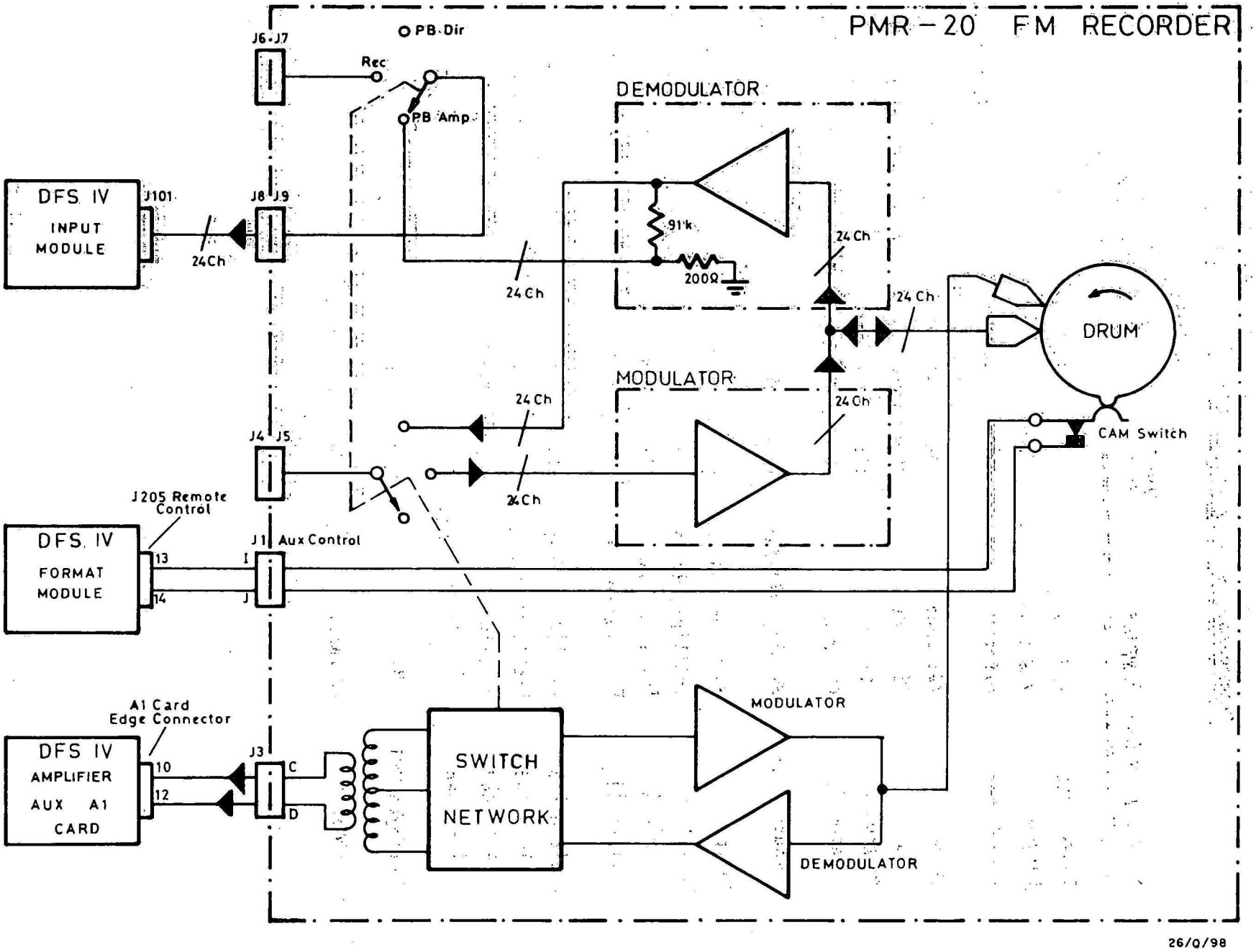

Fig.12 DFS IV-PMR-20 transcription system

TABLE 1

Reprocessed Seismic Survey Lines - Statistics

Survey Line No.	Company	Year Recorded	Analogue Tape Type	Length of Line (km)	Coverage
Barcoo 20B	Marathon	1964	Techno-AM	52	Single-fold
Barcoo 23B	Marathon	1964	Techno-AM	29	Single-fold
Barcoo 24B	Marathon	1964	Techno-AM	12	Single-fold
Bulgroo 4	Alliance	1963	Techno-AM	33	Single-fold
Bulgroo 8	Alliance	1963	Techno-AM	21	Single-fold
Bulgroo 9	Alliance	1963	Techno-AM	26	Single-fold
Bulgroo 12	Alliance	1963	Techno-AM	26	Single-fold
Gumbardo 446	Phillips-Sunray	1962	SIE-FM	19	Single-fold
Quilpie 1	Phillips-Sunray	1960	SIE-FM	35	Single-fold
Quilpie 4	Phillips-Sunray	1960	SIE-FM	37	Single-fold
Quilpie 6	Phillips-Sunray	1960	SIE-FM	4	Single-fold
Quilpie 11	Phillips-Sunray	1960	SIE-FM	27	Single-fold
Welford 645	Phillips-Sunray	1967	SIE-FM	30	12-fold
Welford 646	Phillips-Sunray	1967	SIE-FM	13	12-fold
Welford 647	Phillips-Sunray	1967	SIE-FM	3	12-fold
Welford 648	Phillips-Sunray	1967	SIE-FM	6	12-fold
Thylungra NM1	B.P.	1966	SIE-FM	95	6-fold
Trinidad 1	Alliance	1964	Techno-AM	13	Single-fold

TABLE 2

PROCESSING SEQUENCE FOR THE SEISMIC SECTIONS

1. Analogue to digital transcription by BMR
2. Static computation by BMR
3. Gain recovery
4. Preliminary section with supplied velocities
5. Velocity Analysis - Velpac every 20 records
6. Residual static determination
7. Normal moveout correction
8. Time variant deconvolution
9. Time variant filter
10. Time variant scaling
11. Final display